SOCIAL BENEFIT – COST ANALYSIS OF THE RENGALI MULTI – PURPOSE PROJECT, ORISSA

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By

BINAYAK RATH

to the
DEPARTMENT OF HUMANITIES AND SOCIAL SCIENCES
INDIAN INSTITUTE OF TECHNOLOGY, KANPUR
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CERTIFICATE

This is to certify that the thesis "Social Benefit - Cost Analysis of the Rengali Multi-purpose Project, Orissa", submitted by Binayak Rath in partial fulfilment of the degree of Doctor of Philosophy to the Indian Institute of Technology, Kanpur, is a record of bonafide research work carried out by him under my supervision and guidance. The results embodied in the thesis have not been submitted to any other university or Institute for the award of any degree or diploma.

March, 1980

G.P. Keshava
G.P. Keshava

CERTIFICATE

This is to certify that Mr. B.Rath has satisfactorily completed all the course requirements for the Ph.D. programme in Economics. The courses include:

H-Eco 732	Econometrics
H-Eco 733	Theory of Economic Policy
H-Eco 736	Industrial Organization and Policy
H-Eco 738	Applied Econometrics
H-Eco 739	Price Theory
H-Eco 740	Inter-Industry Economics
H-Eco 741	Project Economics
H-Soc.732	Sociology of Development

Mr. B.Rath was admitted to the candidacy of the Ph.D. degree in March 1977 after he successfully completed the written and oral qualifying examinations.

K.C. Sharma

Head
Department of Humanities &
Social Sciences

Convener
Departmental post-graduate
Committee

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Binayak Rath

CONTENTS

PRINCIPAL ABBREVIATIONS USED

ADM	-	Additional District Magistrate
AEO	-	Agriculture Extension Officer
BDO	-	Block Development Officer
BS & E	-	Bureau of Statistics and Economics
CAD	-	Command Area Development
CADA	-	Command Area Development Authority
CCE	-	Chief Construction Engineer
CEA	-	Central Electric Authority
CWC	-	Central Water Commission
CW & PC	-	Central Water and Power Commission
DAO	-	District Agriculture Officer
DAFP	-	Director of Agriculture and Food Production
EE	-	Executive Engineer
FA & CAO	-	Financial Adviser and Chief Accounts Officer
GPO	-	Gram Panchayat Officer
I & PD	-	Irrigation and Power Department
MIP	-	Medium Irrigation Project
NH	-	National Highways
OECD	-	Organisation for Economic Cooperation and Development
OSEB	-	Orissa State Electricity Board
PHD	-	Public Health Division
PWD	-	Public Works Department
RMP	-	Rengali Multi-Purpose Project
SDO	-	Sub-Divisional Officer
SE	-	Superintending Engineer
UNIDO	-	United Nations Industrial Development Organisation
VAW	-	Village Agriculture Worker

SYNOPSIS

SOCIAL BENEFIT - COST ANALYSIS OF THE RENGALI MULTI-PURPOSE PROJECT, ORISSA

- A thesis submitted in partial fulfilment of the requirements for the Degree of Doctor of Philosophy by Binayak Rath to the Department of Humanities and Social Sciences, Indian Institute of Technology, Kanpur, January 1980.

In a planned economy like India, where the investment allocations are by and large predetermined at the national level, there is an urgent need to utilise the scarce resources in such a fashion that the targets set in the national plans are fully achieved. Once the overall plan allocation is made, the problem to be tackled is how to maximise the net benefits from investment, which in turn envisages the problem of ranking the alternative projects. Hence, here lies the importance of the social benefit - cost analysis (henceforward referred to as SBCA) in a planned economy. Whilst the pursuance of one planned objective retards the furthering of another objective, the SBCA could provide an analytical tool for reconciling the possible conflicts between the objectives. Secondly, the SBCA could throw a lot of data for better understanding of the problem whenever there are conflicts of interests between various state Governments and also between the different agencies of the Central and the State Governments. Thirdly, since there is considerable impact of Government investment

policies on the private entrepreneurs, the application of the SBCA would provide a broader information - base for rational decision-making. With the help of the SBCA techniques an assessment of the net contribution of a project towards the defined objectives of the national plan would be made and thereby the projects could be ranked for the choice of the decision-makers.

But unfortunately, although the Government of India has accepted the role of SBCA in decision-making, in actual practice it appears that the authorities concerned are yet to make the necessary exercises in this direction. Many important aspects of project benefits and costs are being neglected in the feasibility studies of projects. Generally the external effects of investment are not taken into account in the official works on estimation of benefits and costs. The importance of using shadow prices is not being adequately appreciated. While the Government avows some general objectives in respect of income distribution, the feasibility studies of the projects do not introduce any premium for regional or group income redistribution in estimating the net benefits. Thus, briefly we can say that the methods adopted by the Government suffer from a large number of drawbacks.

In the present study an attempt has been made to evolve and apply a sophisticated method of project evaluation to a

public sector project in an economically backward region of India. The method adopted in the study is superior to what has been done by the Government and other non-Government agencies in India in the past. Firstly, we have developed some improved methods for calculating benefits and costs. Further, we have been able to quantify some of the indirect benefits. Secondly, premiums for regional income redistribution have been introduced in estimating the net benefits of the project. Thirdly, in computing the social values of inputs and outputs, proper adjustments to the market prices (in the form of shadow prices) have been made by us. Also care has been taken to incorporate the inter-temporal time preferences in estimating the NPV of the project by applying a social discount rate.

All these exercises have been conducted with reference to a multi-purpose river valley project, viz., the Rengali Multi-purpose Project. The first stage of the project, across the river Brahmani, is under construction in one of the backward areas of Orissa. In the feasibility study of the project we have identified a number of shortcomings. In the revised estimate of the project, the flood control benefits have apparently been manipulated in order to pass the test of feasibility. Some of the assumptions used in the study are highly unrealistic. Although there are two major objectives of the project, namely, flood control and power generation, there has been no attempt by the authorities to quantify the power generation benefits. The B-C ratios used

for the feasibility test are also faulty on many counts.

This project has been selected by us for our empirical verification because here the benefits and costs are wide-ranging. Besides such a project could pursue simultaneously the various objectives of the national plan. Thus, as such, a project like this provides a good scope for the application of SBCA to a public sector project.

In accomplishing the exercise in hand, we have generally adopted the approach suggested by the UNIDO in the book, "Guidelines for Project Evaluation(1972)". Adhering to the above approach we have calculated the benefits and costs of the project in relation to the broad objectives of economic development stated in the Fourth Five-Year Plan of India. However, with respect to the quantification of the indirect benefits we have, at least, moved one step ahead of the Guidelines. While the authors of the Guidelines are somewhat pessimistic about the estimation of indirect benefits, here in this study, we have been able to quantify some of the indirect benefits of the project, which would flow to the economy in the form of externalities.

In addition to these improvements, following the approach advocated in the Guidelines in respect of the calculation of net benefits, we have introduced the shadow prices of inputs and outputs of the project. Some of the relevant shadow prices have been either estimated or approximated by us with the help of some

pre-determined national parameters. Moreover, we have attempted to solve some of the conceptual problems involved with the measurement of benefits and costs of the project at a given point in time and weighing them when they exist at different points of time.

The data used in this study have been collected from various sources during our field trips to Orissa. In addition to considerable useful information available from the project authorities we have collected data from both secondary and primary sources. The secondary sources of data have been the relevant Government files maintained in different offices. In order to project the indirect flood control benefits of the project we have undertaken a primary survey in the Mahanadi flood-plain because the Hirakud Dam Project, across the river Mahanadi, in Orissa has been selected by us as the control project for our analysis. The method of primary data collection has been a rough and ready random sampling method via direct contact and open enquiry.

With the help of the primary and secondary data we have estimated the annual benefits and costs of the project starting from the period of commencement of the construction works to the 50th year of the life-span of the project. As stated above, these have been measured in terms of the broad goals of economic development laid down in the 4th Plan of India. Further, in quantifying the benefits and costs in monetary terms we have used

the 1973 prices as the base year prices. When the figures available to us were in terms of different year price levels, we have applied a standard deflator to convert them to the base year level.

According to our estimate the average annual damage aversion benefits of the project would be around Rs.255 lakhs as against the estimate of the same at Rs.665 lakhs of the project authorities. Our projection of the indirect flood control benefits in the form of agricultural development in the flood-plain has demonstrated that these benefits would be much more significant and worthwhile to the society. While these benefits have been estimated to be nearly Rs.1043 lakhs per annum in the initial years of operation of the project, they would rise to nearly Rs.4181 lakhs per annum after the maturity stage of the project. These figures have been extrapolated on the basis of our findings from the primary survey undertaken in the control project area.

With regard to the calculation of power generation benefits, first we have calculated these benefits with the help of the conventional engineering methodology and then introduced our own methodology of estimation. While in the conventional approach these benefits have been approximated to be around Rs.261 lakhs per annum initially, by our method the same worked out to be nearly Rs.700 lakhs.

Completing the calculations of the project benefits and costs in terms of aggregate consumption gains, we have then introduced another objective of planning into the analysis. This is with respect to regional income redistribution. By applying suitable premiums for this purpose we have brought corrections into the estimates of the consumption benefits and costs of the project.

In case of cost calculations, the first approximation has been based on the market prices of inputs and raw materials. Gradually we have brought adjustments to them to find out the social costs. Thus, in the second approximation of cost calculations the shadow prices have been introduced. In the third approximation of costs the transfer payments like compensation for land and property, and the taxes (subsidies) have been excluded because they are not considered as social costs in terms of opportunity foregone.

Lastly with the help of these detailed estimates of benefits and costs of the project, we have attempted to test the feasibility of the project. In measuring the feasibility we have adopted the well accepted decision-making criteria of discount cashflow method, namely, the NPV, B-C ratio and the IRR. Moreover, to compute the values in terms of inter-temporal preferences, we have accepted the standard social discount rates. The generally prescribed social discount rates for projects in India are 8%, 10% and 12%. Then to simplify our problem of computation we have

developed a standard computer programme and the computer results have been used by us to test the feasibility of the project. Our results have proved that the Rengali Multi-purpose Project is a socially viable project and hence its inclusion in the Fourth Plan allocation of funds has been justified. In the end, on the basis of our field observations and results we have drawn upon a series of policy imperatives for the Government whereby the potential benefits of the project would start occurring to the society without any delay.

The main contribution of the thesis lies in its methodology of calculation of benefits of flood control as well as power generation, and more particularly in the area of quantification of the indirect benefits. Furthermore, the study has evinced that the indirect flood control benefits of a multi-purpose river valley project are much more prominent and significant than the direct flood control benefits and hence, should not be neglected in determining the feasibility of such projects.

CHAPTER I

SCOPE OF SOCIAL BENEFIT - COST ANALYSIS

1.1 INTRODUCTION:

In most developing countries of the world, irrespective of their social and political systems, the national Government of the country strives to bring about rapid transformations in the economy through a process of planning. Notwithstanding the differences in the techniques of planning in these countries, the basic objective is the same, viz., increasing the social welfare accruing to the community. Thus, it becomes imperative on the part of the Government of a developing country to pursue policies that are in the national interest. In order to promote social welfare, the Government generally guides the development activities through various methods including direct investment in the public sector, imposition of controls on private investment and monetary and fiscal regulations.

In recent years most of these countries have channelised more and more of public funds for the development of their "social and economic infrastructure" like the communication and transport systems, educational opportunities, medical facilities, construction of dams and canals etc. Further, to promote efficiency in production the Governments have put within their perview the management of "collective activities" such as municipal water supply, power generation and supply,

flood protection schemes, operation of railways, and posts and telegraphs, etc. As a result, the Governments have initiated the lead in sponsoring a number of projects to meet these ends and hence, the public expenditures in these countries have been increasing steadily. This upward movement of public expenditures tends to put severe strains on the finances of these Governments, and owing to the scarcity of resources they are compelled to make intelligent selections from amongst the alternative projects they might undertake. Among a large number of competing projects only a few could be chosen for implementation at a time on account of financial constraints. To ensure proper utilization of the scarce resources, a careful analysis of the worthwhileness of projects becomes inevitable. Projects need to be formulated and evaluated in such a way as to single out for implementation those that contribute most to the ultimate objectives of the economic policies of the Government. Then it follows that the Government needs a technique of analysis as well as expert knowledge for comparing and evaluating alternative projects in terms of their contribution to these objectives.

The social benefit-cost analysis (henceforward referred to as SBCA) provides a technique for the evaluation of such projects. The SBCA is used as a tool for selection of projects under the framework of planned development. It

provides the criteria for selection of specific projects, whereby the net social benefits from any investment are maximised.

1.2. SCOPE OF SBCA:

The SBCA is essentially a tool to formulate and evaluate a project in terms of the explicit national objectives underlying development planning for the nation as a whole. According to Marglin, "BCA is an aid to implementation of the strategy of development, not a substitute for strategy".[1] The SBCA purports to describe and quantify the social advantages and disadvantages of a policy in terms of common monetary units. It takes into account the concept of national welfare, which is generally articulated in the national objectives outlined in the national plan. Further, it attempts to solve some of the tactical questions which may remain unresolved in the strategy of growth embodied in the plans. In addition to the modifications in the prices of inputs and outputs, the introduction of the social rate of discount and the system of weights in the calculation of social benefits and costs have extended the scope of SBCA to the decision criteria of efficiency and equity. In SBCA, the economists or project evaluator asks

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1. Cf. Stephen A. Marglin, "Public Investment Criteria" George Allen & Unwin Ltd., 1973.

whether the society as a whole will be better off by undertaking a project rather than not undertaking it, or by undertaking, in stead, any of a number of other projects.

In the initial years of its application, the scope of SBCA was limited to a few areas like multi-purpose river valley development, transport, irrigation and power projects. Then it was extended to various industrial projects to tackle some tactical questions at the project level, such as questions related to product-mix, size and location of the plant, choice of technology, use of raw materials and inputs, degree of specialization and expansion, etc. However, of late, we find a wider application of this technique even to the areas of education, health, recreation, family planning, pollution control, etc. Thus, the interest in SBCA for assessing the net overall impact of any investment on society as a whole has significantly increased in recent years.

The scope of SBCA has been further widened due to the development of various improved methodologies of project appraisal and the growing interest of the professional economists as well as the international organizations like OECD, UNIDO and IBRD. As a consequence, many improvements have been brought in the literature on SBCA in recent years.

1.3. ROLE OF SBCA:

The developing countries of the world normally face the problem of scarce resources including capital, skilled labour, entrepreneurship and technical know-how and hence, they must guard against any wasteful use of these resources. It is also widely recognized that there are imperfections in the market structures and in the price mechanism. Owing to these imperfections and tight resource position, any decision based on the rules of the thumb or on political considerations would lead to mischannelisation or underutilization of the scarce resources in the economy, which, in its turn, would lead to loss of social welfare (measured with reference to the objectives of national planning). Under the above circumstances the SBCA plays a significant role because it helps to ensure an efficient allocation of scarce national resources among the investment projects. The SBCA guides the optimum resource utilization in the economy, as well guides the effectiveness of the use of resources in order to promote social welfare.

1.4. ROLE OF SBCA IN INDIA:

In a planned economy like India, where the technique of partial planning has been adopted for promoting economic development and where the investment allocations are by and large predetermined at the national level, the process of

planning broadly involves three different kinds of exercises. In the initial stage, the broad goals of planning are determined by the national Government. Once the goals and the corresponding national economic targets are determined, then in the second stage, the investible resources are allocated among the different sectors of the economy in the light of capital-output ratios. After the overall plan allocation is completed, in the last stage of planning the projects are designed to carry out the strategic goals of the plan. The problem to be tackled at this stage is how to maximise the net social benefits from investment by making an appropriate choice in respect of (i) the location of the project and (ii) the technique of production. The projects that contribute most to the social welfare should be selected for implementation. For a rational decision-making the projects need to be formulated, evaluated and then ranked as per their contributions to the national objectives. Therefore, in a developing economy like India the SBCA acts as a necessary tool for project planning.

Moreover in the Indian context sometimes the pursuance of one objective of planning might retard the furthering of some other objective. Under these circumstances the SBCA could provide an analytical tool for reconciling the possible conflicts between these objectives. Secondly, whenever there

are conflicts of interest between various state Governments as also between the different agencies of the central and state Governments, the SBCA could throw a lot of data for a better understanding of the problem. Thirdly, since there is considerable impact of public investment policies on private entrepreneurs, the application of SBCA would provide a broader information base for rational decision-making, Lastly, the application of SBCA (either pre-evaluation analysis or post-evaluation analysis) to the projects would provide guidance for the ensuing changes in plan allocations as well as plan targets in the succeeding plans of the country because of the close interaction between project analysis and plan formulation. There is a mutual "feedback" between the project analysis on one hand and the formulation of macroplans on the other.[2]

Particularly, in the Indian context there exists a mutual "feedback" between the project analysis and the macroplan formulation. Let us examine how this "feedback" exists in this country. As mentioned earlier, in the third stage of planning an intelligent choice is to be made in the selection of projects at the micro level. From among a number of competing projects a few could be chosen at a time due to

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2. For a detailed discussion on these points, see, I.M.D. Little & J.A. Mirrlees, "Manual of Industrial project Analysis for Developing Countries, Vol. II, SBCA", OECD Development Centre, Paris, 1968.

tight resources positions. Hence, there arises the need for project appraisal or project analysis. In conducting these exercises, the project evaluator has to depend on the feedback from the national plan. He has to measure the benefits and costs in terms of the broad goals of the national plan. For the determination of shadow prices of inputs and outputs as well as the values of premiums (for planned objectives other than aggregate consumption objective) he has to be acquinted with the policies specified in the macroplan. Thus, we can say that for the ex-ante as well as ex-post evaluations of projects he has to depend very much on the broad objectives of the macroplan. On the other hand, the ex-post evaluation of projects also provides guidelines for resource allocation, thereby provides a lot of data for formulation of the macroplans. On the basis of the guidelines derived from ex-post evaluation of projects the macro-plan is to be reformulated in the subsequent years. That is why the planning commission, GOI gives more priority for the post-evaluation of projects.

1.5. APPLICATION OF SBCA IN THE EVALUATION OF MULTI-PURPOSE RIVER VALLEY PROJECTS:

The application of SBCA owes its origin to the water-resource development projects with multiple objectives because of the special characteristics associated with these projects. Some of the peculiar characteristics that could have inspired

the application of SBCA to these projects are:

(1) These projects are generally resource development projects;

(2) They require huge amount of public investment as well as resources for their construction;

(3) They are characterised by a long gestation period;

(4) Since they too have a long life, the benefits and costs flow for a longer period of time as a result of which both the present and future generations are benefited;

(5) When the benefits start flowing from these projects, these normally flow to a large section of the population at a time, but not to any individual alone. Thereby, the social welfare is promoted to a great extent;

(6) Another peculiarity of these projects is that while they provide benefits to a definite section of the population, they may create positive inconvenience to another section of the population, whose land and property will be submerged by the reservoir; and

(7) The externalities associated with these projects are so wide-ranging that these affect various sections of the population directly or indirectly. Usually these spill-over effects percolate to different regions and different groups of people.

On account of these above peculiar characteristics of the multi-purpose river valley projects, no private enterprise is likely to come forward for making investment in these projects. As such, the Government has to step in for the optimal development of what may be described as water resources. When the Government enters into the picture, the various objectives of the project are to be laid down in conformity with the objectives of national planning. The benefits and costs expected to accrue to the present and future generations are to be incorporated into the analysis for selecting the project and they are to be standardised by using the prices of the base year. The distortions in the market prices of inputs and outputs are to be corrected for ensuring proper utilization of the scarce resources at the project level. Inter-temporal choices or social time preferences are also to be included. Thus, the commercial profitability analysis is substituted by the social benefit- cost analysis.

In many developing countries while irrigation facilities are providing enough incentives for the green revolution and while power generation and its utilization is helping resource development in both industries and agriculture, the rising magnitude of flood losses is retarding the agricultural development to a great extent. Further, the frequency and magnitude of flood damages are increasing year after year.

Therefore, the Governments of these countries in their attempt to tackle these problems are tending to undertake multi-purpose resource development including flood control, irrigation and power generation, etc. But sometimes the allocation of scarce resources between the competing uses may give rise to various "trade-off" situations. For example, with the limited water impounded in the reservoir of a project sometimes it may not be possible to accomplish the demands of irrigation and powergeneration or the demands of irrigation and domestic or industrial uses simultaneously. Under such circumstances, the application of SBCA provides the best tool available in examining the"trade-off"relations and thereby, helps a rational decision-making.

In a country like India, the application of SBCA to a multi-purpose river valley project becomes unavoidable for the simple reason that all the projects demanded by the various state Governments may not be sanctioned in any given period due to limitations of investible funds. In such a situation, on the basis of the results of SBCA the proposed projects are to be ranked in order of priority by the funding authorities. Furthermore, the application of SBCA to any such project under construction would help the Government to frame a sound economic policy relating to the project in future years.

1.6. SCOPE OF THE STUDY:

The present study proposes to evolve a suitable methodology for project appraisal and then evaluate a multi-purpose river valley project, namely, the Rengali Multi-purpose Project (henceforward referred to as RMP), across the Brahmani in Orissa. In chapter II we have introduced the RMP - its background and brief history along with a description of the Brahmani river system. The methodology of project evaluation as well as our justifications for preference of the UNIDO Guidelines method are discussed in the third chapter. Chapter IV deals with our methods of data collection and the modifications introduced with relation to the treatment of data. In the subsequent three chapters we have dealt with the calculation of benefits and costs in terms of the broad goals of the national plan. The indirect benefits and external effects are also quantified in these estimations. Further, the shadow prices of inputs and outputs are introduced into the calculations. In addition to these modifications, the benefits and costs are also adjusted to the objective of regional income redistribution. The main contributions of the study are highlighted in these chapters. Then in chapter VIII, with the help of the detailed estimates of benefits and costs we have attempted to measure the social economic feasibility of the RMP with the help of the discount cash flow methods, viz., the NPV, B-C

Ratio and the IRR. Our SBCA results have shown that the RMP is a socially viable project. The last chapter of the dissertation contains the conclusions and policy implications drawn from the findings of the analysis.

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CHAPTER II

THE RENGALI MULTI-PURPOSE PROJECT

2.1. BACKGROUND OF THE PROJECT:

The three coastal districts of Orissa, Cuttack, Puri and Balasore, with alluvial plains and high concentration of population, were subjected to the vicissitudes of high floods from time immemorial. The three major rivers of Orissa, the Mahanadi, the Brahmani and the Baitarani were causing enormous damages in the valleys and plains and their ravages tell a grim and sorrowful tale of the sufferings of the people.[3] Considering the magnitude and seriousness of the problem of floods and draughts in the delta, even the British Government did not hesitate to make certain attempts to tame these rivers by constructing weirs at a number of places. Sir Arthur Cotton, the pioneer of the flood control and irrigation scheme of Orissa[4], envisaged that the construction of weirs, while controlling floods, would provide opportunities for irrigation

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3. See: "Floods in Orissa Rivers, 1955-56, Final Report" Revenue Department (Special Relief), Government of Orissa, Bhubaneswar, 1957.

4. Ref: as above.
Col.Arthur Cotton's Scheme (1858) consisted of:-
i) Weirs across the Mahanadi, Brahmani and the Baitarani;
ii) Irrigating channels completed for navigation throughout the whole delta tract;

(contd.)

and navigation and thus would bring about an increase in the revenue of the state. While the scheme was helpful for irrigation and navigation, its flood control value was rather limited. The weirs and canals created more havoc during floods by obstructing the free flow of flood waters.

The devastating floods of 1925, 1926 and 1927 in the major rivers of the state prompted the Government of Bihar and Orissa to set up a Flood Inquiry Committee to probe into the causes of floods and suggest remedial measures. This committee was advised by Sir M. Vishwashwarayya. After examining the various causes of floods in the Brahmani, this committee recommended the demolition of the weir at Jenapur across the Brahmani. Again following the disastrous floods in 1937 in all rivers, Sir Vishwashwarayya was further requested by the Government of Orissa to advise them on the flood control problem. Sir Vishwashwarayya, who stressed the great need for detailed scientific surveys and continuous observations of the rivers and the delta, visualised flood control by the construction of water reservoirs. He stressed

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(contd.)

iii) Drainage channels between all irrigating channels;

iv) Embankments to all rivers; and

v) The high level channel to Calcutta which would also irrigate extensively.

the multi-purpose nature of such reservoirs; "if a reservoir is constructed it may prove useful in several other ways as well - for extending irrigation, generation of electric power, etc. Once floods come under effective control the whole area may be transformed into a prosperous region."[5]

As a result of the recommendations of Sir Vishwashwarayya, a Flood Advisory Committee was set up in 1938, which studied the problem continuously for four years and gave its final report in 1942. This Committee was of the opinion that the question of storage reservoirs should be taken up for investigation only after other cheaper methods had been tried and their results were known. However, the Committee emphasised on the construction of reservoirs across the rivers in the valleys (rather than weirs) to ensure flood control and irrigation. Following their suggestions the Government of India approved the plan of construction of the Hirakud Dam Project across, the largest river of Orissa, the Mahanadi, which was causing the worst flood hazards with a large number of branches ending up in a network of channels in the delta.

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5. Source: Prof. N.V. Sovani & N.Rath, "Economics of a Multi-purpose River Dam: Report of an Inquiry into the Economic Benefits of the Hirakud Dam", Gokhale Institute of Politics & Economics, Poona, 1960.

With the coming up of the Hirakud Dam in 1957, the floods in the Mahanadi system were controlled, but the other two rivers, the Brahmani and the Baitarani continued to threaten the plains. And towards the later part of sixties and early seventies the damages caused by them reached significant levels. Particularly, the Brahmani caused serious flood havoc in its delta. Almost every alternative year it brought untold miseries to the inhabitants of the Cuttack and Dhenkanal districts.

Thus, systematic efforts began in the early seventies to control the floods in the Brahmani and the Baitarani. Detailed investigations were undertaken by the Government of Orissa and all possible alternatives were examined. Finally, the Rengali Multi-purpose Project, across the Brahmani with the twin objectives of flood control and power generation was approved by the CW & PC as well as the Planning Commission, Government of India and hence, was included in the Fourth Five-year Plan's allocation of funds. The construction of the first phase of the project has commenced with the laying up of the foundation- stone by the Prime Minister of India in December 1973 at village Rengali in district Dhenkanal. The location of the project is shown in Annexure II/Map 1.

2.2. THE BRAHMANI SYSTEM:

Brahmani, the second largest river of Orissa, originates from Vedavyas, a place near the steel township of Rourkela, at the confluence of the Sankha and the Koel, both flowing from the Chhotanagpur hills of Bihar. Then the river meanders its course through different parts of Sundergarh, Sambalpur, Dhenkanal and Cuttack districts of Orissa and at the end falls into the Bay of Bengal at Dhamra near Chandabeli of Balasore district. The river flows for 345 miles through the hill-ranges upto the head of the delta Jenapur and then intercepts through the alluvial plains and litteral tracts of the Cuttack district for 93 miles until it joins the sea. The salient features of the river are given in Annexure II/ Table No.1 along with other details relating to the other two major rivers of Orissa.

(a) WATERSHED:

The watershed of the Brahmani falls in between the watersheds of the Mahanadi on the right and the Baitarani and the Subarnarekha on the left. The catchment extends upto 36,260 sq. kms (14,000 sq. miles) at the head of the delta. The Brahmani receives its supplies from the slopes of the Chhotanagpur, Singhbhum and Lohardaga and Ranchi districts of Bihar, and Sundergarh, Mayurbhanja, Keonjhar, Sambalpur,

Dhenkanal and Cuttack districts of Orissa. The map showing the watershed areas of these rivers are given in the Annex.II/ Map. 2.

(b) TRIBUTARIES:

Besides the Sankha and the Koel, the other main tributaries of the Brahmani are:-

(i) Gohira, flowing from Deogarh and Bamra hills, joins the Brahmani near Gogua of Sambalpur district;

(ii) Tikira about 125 miles long has its source from the Sureswari hills and Handapa hills and merges with the Brahmani near Kaniha in Talcher;

(iii) Singda having a length of about 72 miles rises from the Sarisua hills and joins the main river near Talcher;

(iv) Nandira about 135 miles long, flowing from the Durgapur hills, joins the Brahmani at Talcher;

(v) Nigra about 110 miles long has its source in the hills between Angul and Athamalik and joins the main river at Kharagprasad in Dhenkanal;

(vi) Mankada , flowing from Pallahara and Keonjhar hills, joins the Brahmani 2 kms above the Rengali Dam Site;

(vii) Samakoi has its source from the Malayagiri hills of Pallahara and Keonjhar hills and joins the main river

near Gaham in Talcher;

(viii) Ramial, flowing from the Dandadhar hills of Kamakhya-nagar and the adjoining hill ranges of Keonjhar district, joins the Brahmani near Bhuban in Dhenkanal; and

(ix) Damsal, flowing from the Daitari hills of Cuttack, joins the main river near Bhuban.

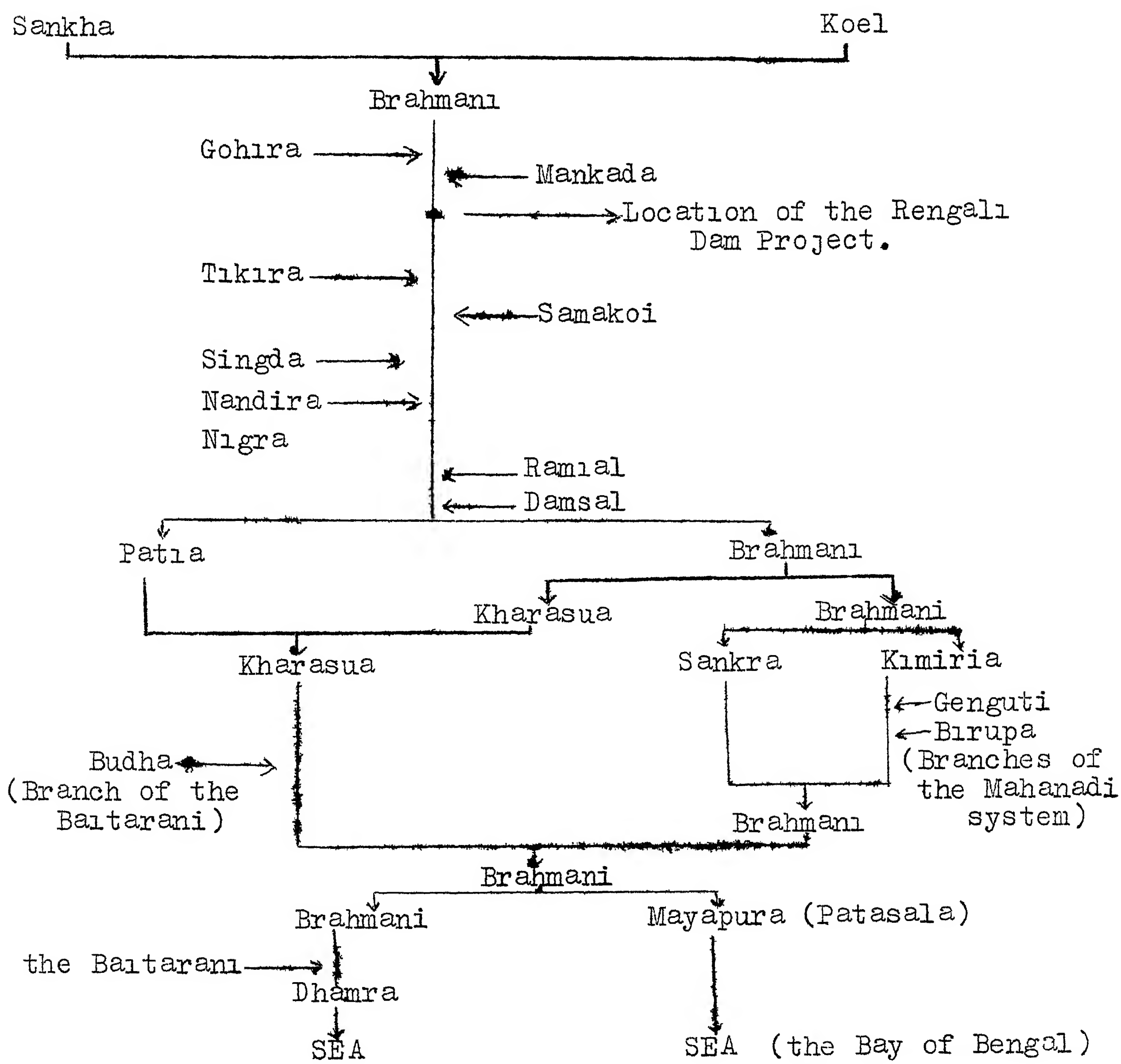
(c) BRANCHES:

The Brahmani enters the plains 10 miles above Jenapur nearly opposite which a branch called Patia takes off to the north. The Kharsua branch takes off near Manpur, but the mouth of Kharsua is closed by an embankment. From the original off-take at Manpur to the point of confluence with Patia, the Kharsua is a dead channel, but is however flooded by the backwaters from Patia. The stream than becomes known as Kharsua. Lower down, the Budha, a branch off from the Baitarani joins the Kharsua near Kamalpur when the stream runs in one channel till it meets the Brahmani below Aul. Twelve miles east of Jenapur the Brahmani gives off another branch to the south called Kimiria and the main stream assumes the name Sankra. The Kimiria joining the Genguti and Birupa, the branches of the Mahanadi, meets the main stream near Indupur. The combined stream flows past Pattamundai and Alva till it is joined by the Kharsua. The channel then forks

to the right assuming the name Mayapura (Patasala) which falls into the Bay of Bengal below Rajnagar, while the left main stream is joined by the Baitarani near Chandabali and assumes the name Dhamra till it meets the sea.

The schematic diagram given below explains the Brahmani system:

THE BRAHMANI SYSTEM



2.3 THE BRAHMANI FLOOD-PLAIN:

The Brahmani flood-plain for our analysis includes all the areas which are susceptible to floods in the Brahmani system and which are also expected to be protected from the ravages of floods after the construction of RMP. This flood plain consists of parts of the valley starting from Talcher subdivision of Dhenkanal district upto the head of the delta Jenapur and the alluvial plains as well as the littoral tracts between Jenapur and the Bay of Bengal. It comprises of nearly 1,524 number of villages of 24 blocks and 3 NACs/Municipalities of Dhenkanal and Cuttack district, with a population of nearly 10 lakhs[6]. The cultivated areas subjected to floods from the Brahmani system are around 3.35 lakh acres. The block-wise statistical details of the flood-plain are given in Annex.II/ Table No.2 and the block headquarters of the flood-plain are shown in Annex. II/Map. No.3.

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6. Note that there are some discrepancies between our classification of the Brahmani flood-plain and that of the Project authorities. While the Project authorities have not taken into consideration the areas of Talcher, Dhenkanal and Kamakhyanagar subdivisions of Dhenkanal district, and also parts of the Sukinda and Donagadi blocks in Cuttack district, we have included all these areas for the purpose of our projection of benefits because these areas were being regularly flooded by the Brahmani. Further more, the project map has shown some of the areas to be provided with flood relief from the RMP, those which were never affected by the floods of the Brahmani system.

It would be incorrect to regard the Brahmani flood-plain as a compact physical, economic, sociological or cultural unit, for there are differences between the lower valley, the mountaineous tract and the plains. On the basis of physical structures the Brahmani flood-plain has been broadly divided into three parts: (i) the plains between the mountaineous tracts upto Jenapur (the middle flood-plain), (ii) the alluvial plains between Jenapur and Pattamundai (the lower flood-plain), and (iii) the rest belongs to the littoral tract (the lowermost flood-plain). While the middle flood-plain is endowed with varieties of abundant natural resources like forests and minerals its greatest problem is poverty and backwardness. Whereas the lower flood-plain (the delta) comprises of a fertile tract of land. The inhabitants are educated and cultured. Although they enjoy more of developmental facilities in comparison to their counterparts in the valley, they bear a greater burden of flood hazards in the monsoons due to the net-work of branches of the river.

2.4. BRIEF HISTORY OF THE PROJECT:

Public interest in the problem of Brahmani floods dates back at least to 1927, when the heavy floods in the Brahmani delta prompted the Government to set up the Flood Inquiry Committee to probe into the causes of Brahmani floods and suggest remedial measures. As the Committee recommended for

the demolition of the weirs at the head of the delta, the weirs were demolished in 1930 making the High Level Canal Range II defunct. But nothing approaching a multi-purpose development of the Brahmani had emerged from the Enquiry Committee. Since then, no attempt was made to harness the river till 1956 when a dam across the river Sankha at Mandira was constructed by the HSL for ensuring regular supply of water to the steel plant at Rourkela.

After the construction of the Hirakud Dam, whereby the floods in the Mahanadi were moderated to a great extent, the attention of the Government was diverted to the problem of floods in the Brahmani system. Therefore in 1959 of was proposed by the Government of Orissa to construct a dam at Rengali to impound 3.25 lakh Ham (2.644 m. acre feet) of water for providing irrigation to 16,200 hectares of land and to generate 38 MW of power. But this proposal was dropped as the benefits were considered to be too little. However, in 1963 Dr. A.N. Khosla, the then Governor of Orissa, prepared an integrated scheme for the development of the major river basins in Orissa, in which he proposed to build a dam across the Brahmani at Barkot intercepting a catchment of 22,900 sq. kms. for diversion of a part of the flow to the proposed Tikarpura reservoir across the Mahanadi to increase the power output of Tikarpara power house. This scheme was

investigated during those days but was not taken up since Tikarpara project was deferred, even though the foundation-stone was laid down by Late Pandit Jawaharlal Nehru in April 1964. Further, along with the proposal for setting up a steel plant at Bonaigarh or at Barkot, a new proposal came up for constructing two dams one at Barkot and the other at Lodani for providing water supply to the steel township and for providing irrigation to 54,400 hectares during Rabi season. Again this was also not materialised. Finally in July 1972 the Govt. of Orissa submitted a project report to the CW & PC for constructing a dam across the Brahmani for flood control and irrigation near the village Rengali in Dhenkanal district. Of course, this proposal was approved by the CW & PC and Planning Commission only after undergoing some modifications in the project objectives and designs.

2.5 THE PROJECT AT PRESENT:

In the July 1972 project report it was proposed to create a live storage of 2.99 lakh Ham. for irrigating 3,26,400 ha. of GCA with 2,61,120 ha. of CCA on both left and right of the Brahmani valley and for moderating the flood to 9,900 cumecs (3.5 lakh cusecs) at the head of the delta for flood control. There was no proposal for power generation in the said report. The left and right canals were proposed to be taken off directly from the reservoir so as to command the

valley from a much higher elevation. After thorough scrutiny at the CW & PC level and detailed discussions with the State Government officials, it was finally decided to include hydro-power generation and drop irrigation to the second stage.[7] Then in tune with the discussions with the CW & PC a modified project report, with the B-C ratio of 2.2 (for flood control only), was submitted in October 1972 and the same was approved by the Government of India and hence, was included in the Fourth Five-Year Plan allocation of funds.

(a) COMPONENTS OF THE PROJECT:

The revised proposal for the first stage of RMP envisages to provide flood control benefits to its extensive flood-plain as well as provide opportunities for hydro-power generation from the reservoir. The major components of the project for the above said purpose are: the construction of a solid gravity masonary dam of 1,040 M. length and a dyke, construction of embankments and flood gates, rehabilitation and resettlement of the displaced persons from the reservoir area, construction of the power house, and the installation of the power project.

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7. This particular decision has given rise to a "trade-off" situation of policy making. Rath & Keshava," Trade-off in water use Decisions. A case Study of Rengali Multi-purpose Project, Orissa" presented in the All India Econometrics Conference, Srinagar, 24-26 May, 1979 have proved that the above decision was not an economically viable proposition.

(b) OBJECTIVES OF THE PROJECT:

The primary objective of this project is to control the flow of water in the Brahmani System and moderate the floods to 3.5 lakh cusecs from the maximum discharge of 8.5 lakhs at the head of the delta with a margin error of about 50,000 cusecs. By impounding 5.15 lakh Ham at MWL and 4.40 lakh Ham at FRL, the reservoir, with a waterspread area of 406 sq. kms., proposes to protect 2,600 sq. kms area of the Brahmani delta from the ravages of floods and thereby to benefit 10.8 lakh population. The average annual direct flood control benefit has been estimated to be approximately Rs.6.65 crores.[8]

The second major objective of the first stage of the project is to generate 60 MW of firm power by installing the hydroelectric stations at the base of the dam and subsequently to enhance the generation capacity to 91 MW after construction of the Koel and Karo projects in Bihar. The net firm energy available from the project would be 523 M. KWH initially and 681.8 M. KWH ultimately.

(c) COSTS OF THE PROJECT:

In 1972 the total construction cost for the first stage

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8. These are the estimates of the project authorities.

of the project was estimated as Rs.57.92 crores, with Rs.41.92 crores for dam and appurtnent works and Rs.16.00 crores for power production. By a very crude method of estimation the B-C ratio of flood control, upon which the project was justified, was estimated to be 2.2. However, owing to cost escalations and higher compensations to the people of the submerged area, the revised cost estimate of the project, at present stands at Rs.99.00 crores, with Rs.75 crores for dam and appustnent works and Rs.24 crores for power production.

The salient features of the RMP along with other relevant information for our analysis are given in Annex.II/ Appendix 1.

In spite of the various modifications of the original multi-purpose plan, presently the construction of the first stage of RMP is in steady progress and is scheduled to be completed by 1982-83. Generally it is expected that the completion of RMP would bring a lot of benefits (directly and indirectly) to a backward economy like Orissa.[9] We, in this study, propose to evaluate this first stage of RMP.

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9. Orissa's official designation as a "backward state" appear well justified when one examines Annex.II/ Appendix II, where we have described the various economic indicators of the State vis-a-vis the all-India economic indicators.

CHAPTER III

THE METHODOLOGY OF EVALUATION

3.1 METHODS OF PROJECT EVALUATION:

The history of the application of social benefit-cost analysis goes back to the thirties of the present century in the field of water resource development in the USA. But in those days the methodology was associated with a number of drawbacks and lacunae in respect of the calculation of benefits and costs. The problems of quantification of social benefits and costs, by taking into account the externalities or indirect effects, were not resolved. Adequate care was not being taken to correct the market imperfections and price distortions by the introduction of shadow prices. The inter-temporal effects of net benefits of the project were not taken into consideration.

Furthermore , although the methodologies of project appraisal had their deep roots in welfare economics, very few professional economists were interested in improving the methodologies. Hardly was there any significant attempt to remove the above drawbacks. We notice a systematic effort in these directions only from the fifties onwards. Consequent upon these developments (both in 'theory and practice), three broad methodologies of project evaluation have been evolved,

each emphasising different aspects of evaluation. These methodologies are:

(i) The OECD Manual Method,[10]

(ii) The UNIDO Guidelines Method,[11] and

(iii) The Effects Method.[12]

In addition to these three methodologies, Deepak Lal[13] has mentioned another methodology, viz., Bruno-Krager methodology. But since this methodology takes into consideration

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10. See, I. M.D. Little & J.A. Mirrlees, "Manual of Industrial Project Analysis for Developing Countries, Vol. II, Social Benefit-Cost Analysis", OECD Development Centre, Paris, 1968. A revised edition of this volume has been published under the title, "Project Appraisal and Planning for Developing Countries", Heinemann, London, 1974.

11. See, Partha Dasgupta, Amarty Sen & Stephen Marglin, "Guidelines for Project Evaluation", United Nations, New York, 1972. Certain aspects of this method are common to the procedure recommended by A.C. Harberger and D.M. Schydlowsky.

12. See, Charles Prou & Marc Chervel, "Etablissment des programmes en economie sousdeveloppe'e, tome3, l'e'tude des grappes de projets., " Paris, Dunod , 1970 and Bela Belassa, " The Effects Method of Project Evaluation", Oxford Bulletin of Economics & Statistics, November, 1976.

13. See, Deepak Lal, "Methods of Project Analysis: A Review, " World Bank Staff Occasional Papers, No.16, IBRD, 1974.

some aspects of import, export and exchange control only, we do not accept it as a full-fledged methodology of project evaluation. Among the other three methods mentioned above, the "effects method" is used on a limited scale due to lack of popularity among the users. This methodology is being widely used in the French speaking African countries.

In recent years much attention has been focussed on the OECD Manual and the UNIDO Guidelines methods. These two methods are the two major expositions of modern techniques of project appraisal. Each of them has its own theoretical base and economic justifications. The differences in approaches, assumptions and estimation procedures of benefits and costs between the two methodologies have widely discussed in the literature on SBCA.[14] However, Deepak Lal, whilst comparing and critically evaluating the alternative methodologies of project evaluation has demonstrated that, in principle, both the suggested procedures are equivalent, if the same assumptions are made about the economic environment.[15]

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14. See, "Symposium on the Little - Mirrlees Manual of Industrial Project Analysis in Developing Countries", in the Oxford Bulletin, February, 1972; several articles on the concepts and estimation of shadow price of foreign exchange in the Oxford Economic Papers, July, 1974; and also Deepak Lal, op. cit.

15. Deepak Lal, op. cit.

3.2 APPLICATION OF THESE METHODS IN EVALUATING THE MULTI-PURPOSE RIVER VALLEY PROJECTS IN INDIA

(a) METHODS ADOPTED BY THE GOVERNMENT:

In principle the Government of India has accepted the role of SBCA in undertaking decisions on executing the multi-purpose river valley projects. And as such, usually the CWC and CEA (previously the CW & PC) and the Planning Commission, GOI, insist on B-C ratios of projects to approve any such projects. Sometimes the projects get rejected due to low B-C ratio. In some cases they also suggest some changes either in the objectives (alternatively components) or technical structures to improve the feasibility of the project.

In spite of the general application of this tool in decision-making, the method of calculation of B-C ratios by the Government agencies (in case of multi-purpose river valley projects the project authorities) in India suffers from the following drawbacks.

First, the method of deriving the B-C ratio is very crude and out-dated. Generally no sophisticated method of project appraisal is being adopted by them. Secondly, the benefits and costs of the projects are not properly measured. Many important aspects of benefits and costs are neglected in the feasibility studies of the projects which are prepared

at present. Thirdly, the external and indirect effects of investment are not taken into account in the official works on the estimation of benefits and costs. Fourthly, although it is well recognized that the market prices of inputs and outputs of any project are distorted prices, no adjustments to these prices have been introduced by the Government in measuring the net benefits of a project. In other words, the importance of using shadow prices is not adequately appreciated. Fifthly, the benefits and costs of all components of the project are not taken into consideration in determining the B-C ratio of the project. Sixthly, while the Government avows some general objectives in respect of income distribution among different groups as well as regions, the feasibility studies of projects do not incorporate any premium for regional or group income redistribution. Seventhly, the Government agencies do not introduce the inter-temporal time preferences in estimating the NPV of the project benefits and costs. Lastly, most of the feasibility studies are based on weak and sometimes incorrect data-base. In the absence of adequate data they use many assumptions, which are highly unrealistic and based on no scientific studies.

(b) METHODS ADOPTED BY THE NON-GOVT. AGENCIES:

To the best of our knowledge, there is no study available in India at the moment which has applied any of the

sophisticated SBCA methods to a multi-purpose river valley project. Of course, there are well known studies which have covered some aspects of the overall exercise. The first major study in this area was that of Prof. Sovani & Rath.[16] The objective of the study was to assess, as comprehensively as possible, the benefits that were likely to accrue to the state of Orissa from the construction of the Hirakud Multi-purpose Project across the river Mahanadi, and then to compute the benefit-cost ratio of the project. In accordance with the objectives laid down in the "Plan of Inquiry"[17] an attempt was made to estimate the benefits accruing from irrigation, flood control and power generation objectives of the project and finally the B-C ratio was computed by the authors. The methodology adopted by the authors, however, suffers from the following shortcomings. Firstly, the social benefits and costs were not properly computed. Specifically no attempt was made to estimate the same with reference to the objectives of planning in India. Secondly, there was attempt to incorporate

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16. Prof. N.V. Sovani & Nilakantha Rath, op. cit.

17. The "Plan of Inquiry" was, however, contemplated and prepared by Prof. D.R. Godgil and then forwarded to Member (Designs), Central Water & Power Commission, GOI, for approval.

the concept of shadow prices to care of the distorted market prices. Thirdly, no attention was paid to the important factor of time stream. The costs and benefits for the whole period of construction as well as for the entire lifespan of the project were not considered in the analysis. Fourthly, the concept of inter-temporal time preferences was not introduced, hence, no discounting was done with respect to the benefits and costs for various years. Fifthly, the study neglected the aspect of redistribution and equity which contribute to social welfare of the people. Lastly, generally the study did not attempt to highlight any particular methodology of project evaluation.

However, in spite of these limitations this study was the first and last of its kind available in this country, which attempted to apply benefit-cost analysis to a multi-purpose river valley project. More or less this was the first scientific study that had introduced the indirect and secondary benefits into the analysis. While to some extent they succeeded in incorporating these concepts in the estimation of irrigation and power generation benefits they failed to do the same exercise with respect to the flood control benefits of the project.

Apart from this study, we have come across a few other studies dealing with some aspects of the problem. The six

studies[18], sponsored by the Research Programme Committee, Planning Commission, GOI, may be briefly commented in this connection. Although some of these studies were concerned with multi-purpose projects, the main purpose of these studies, as specified by the RPC, was to investigate the primary and secondary benefits of irrigation only. These were primarily designed to find out how far the major irrigation works satisfied the orthodox financial and modern economic criteria. The benefits and costs were not measured in relation to the broad objectives of planning. Furthermore, in some of these

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18. The Six Studies are:

i) K.N. Raj, "Some Economic Aspects of Bhakra Nangal Project: A Preliminary Analysis in terms of Selected Investment Criteria," Asia Publishing House, 1960.

ii) S.K. Basu, "Evaluation of Damodar Canals: A Study of the Benefits of Irrigation in the Damodar Region," Asia Publishing House, 1963.

iii) S.K. Sonachalam, "Benefit-Cost Evaluation of Cauvery-Mettur Project", Annamalai University, Annamalai, 1963.

iv) Baljit Singh & Sridhar Mishra, "Benefit-Cost Analysis of Sarada Canal System," Asia Publishing House, 1964.

v) Mrs. M.F. Jussawala, "Evaluation of the Benefits of the Nizamsagar Irrigation Project," Osmania University, Hyderabad, 1965.

vi) RPC, Planning Commission, "Evaluation of Benefits of Irrigation: Gang Canal, Rajastan ", Govt. of India, 1967.

studies the B-C ratios were computed in a rather crude manner. Temporal as well as inter-temporal effects were neglected in these studies. Moreover, none of these studies had tried to integrate the other objectives of the project with irrigation objective while computing the B-C ratio. They did not make any attempt to allocate the overhead costs among different objectives, Therefore, strictly speaking, none of these studies would be termed as SBCA study in the modern sense of the approaches and methodologies.

3.3 OUR EVALUATION METHODOLOGY:

As we have mentioned earlier there are two important methodologies of project appraisal and we have to make an intelligent choice between the two. We have preferred the UNIDO Guidelines method rather than the OECD Manual method because the former "offers a more thorough treatment of cost-benefit analysis applied to poor countries than can be found today in any other volume or monograph".[19] The approach seems to be more realistic because they have fully taken into consideration the political and administrative constraints, whether implicit or explicit, in the calculation of the

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19. E.J. Mishan, "Flexibility & Consistency in Project Evaluation", Economica, February, 1974.

national parameters. Moreover, as the UNIDO Guidelines is based on partial equilibrium approach, it is best suited to a country like India which has adopted partial planning,. Owing to these merits we have decided to generally adopt the Guidelines approach in evaluating the RMP.

Since so far, there is no empirical work available in this country following the approach suggested in the Guidelines[20], our exercise would be unique. Further, it would provide an opportunity for examining the effectiveness of this method for evaluating a multi-purpose river valley project of a developing country.

3.4 SOME IMPROVEMENTS INTRODUCED IN OUR STUDY:

In undertaking the SBCA of the RMP, we have attempted to evolve and apply a sophisticated method of project evaluation. In accomplishing the exercise in hand, we have generally adopted the UNIDO Guidelines approach. Adhering to the above approach we have calculated the benefits and

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20. As such there are some empirical evidences of the OECD Manual and UNIDO Guidelines method of project evaluation in India. Deepak Lal's "Wells and Welfare" OECD, 1972, and Mishra & Beyer, "CBA: A Case study of Ratnagiri Fisheries Project", 1946 are such examples available in this country. Of course there is no application of these methods to a multi-purpose river valley project.

costs of the project in relation to the broad objectives of economic development stated in the Fourth Five-year Plan of India.[21] However, with respect to the quantification of the flood control and power generation benefits, we have introduced a slightly different method than what is suggested by the Guidelines. In our methodology of calculation of benefits we have adopted a four-fold classification of benefits, namely, the direct primary, indirect primary, direct secondary and the indirect secondary benefits. More particularly, with regard to the quantification of indirect benefits, we have, at least, moved one step ahead of the Guidelines. While the authors of the Guidelines are somewhat pessimistic about the estimation of indirect benefits, here in this study, we have been able to quantify some of the indirect benefits of the project, which would flow to the economy in the form of externalities. Furthermore, we have been able to devise a new methodology for the calculation of flood control and power generation benefits of a multi-purpose river valley project.

Secondly, in addition to these improvements in the calculation of benefits, in computing the social value of

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21. In computing the benefits and costs of the project, we have decided to define them in relation to the goals or objectives of the 4th plan of the country because the RMP was proposed and approved during the IV Plan only.

inputs and outputs, proper adjustments to the market prices (by the application of shadow prices) have been made by us. Some of the relevant shadow prices have been either estimated or approximated by us with the help of some pre-determined national parameters. Moreover, in estimating the social benefits and costs we have deducted the transfer payments associated with the project calculations.

Thirdly, the benefits and costs of the different components of the project have been taken into consideration in determining the feasibility of the project.

Fourthly, in quantifying the benefits and costs in monetary terms we have used the base year prices. Since time series data were available to us, we have applied a standard deflator to convert them to the base year level.

Fifthly, in the estimation of the net benefits of the project we have introduced premiums to take care of the regional income redistribution effects.

Sixthly, recognizing the possible miscalculations in the Government data we have tried our best to cross examine the data from various sources and then use the rectified data for our analysis.

Finally, in measuring the feasibility of the RMP we have adopted the well accepted decision-making criteria of

discount cash flow methods, viz., the NPV, B-C ratio and the IRR. Moreover, in computing the values of benefits and costs in terms of inter-temporal preferences we have used the standard social discount rates, which are generally prescribed for India.

On account of these improvements introduced in our study, we feel that the methods adopted by us is superior to what has been done by the Government and other non-Government agencies in India in the past.

3.5 SOME SIMPLIFICATIONS:

We know that in spite of increased contributions of many professional economists and in spite of a number of modifications introduced in the evaluation methodologies, there are still some problems with the SBCA. This tool is not yet relieved of value judgements and assumptions. In order to overcome some of these difficulties of this sort, the project evaluator has no other choice but to make some assumptions. Thus, for the sake of simplicity, we have proposed the following assumptions in our study.

First, we have assumed that the structural and technical designs provided by the engineers are the best set of structures and designs that would provide the maximum return on investment to society, i.e., we have not foreseen any alternative

technological development. In other words, we have not attempted to examine the possible errors and miscalculations in the technical feasibility provided by the project authorities. We have considered these factors as exogenous to the project evaluator.

Secondly, the assumptions of the authorities in respect of the location of the project that the location actually chosen is the best location available in the valley has been accepted by us. No alternative locational possibility has been examined by us.

Thirdly, we have assumed no uncertainty about the results of the project. Following this assumption no probabilistic approach has been introduced at the first instance of our evaluation.

Fourthly, in order to internalize some of the externalities or spill-overs, the methods of approximation are being adopted where no data were available and they are assumed to be the best set of approximations possible.

Lastly, we have assumed that with the given human and managerial skills, the project construction, and operation and maintenance would be handled in the best possible manner. Errors and miscalculations in the human and managerial fields are being ignored in our analysis.

Although all these above assumptions are questionable and scientific studies are possible in respect of each one of them, we have decided not to go beyond our assumptions to avoid certain complications. Thus, we have to proceed with our appraisal within the limitations of these simplifications, which, more or less, define the boundaries for our study.

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CHAPTER IV

THE DATA

4.1 IMPORTANCE OF DATA:

Any scientific analysis needs a set of correct data that could provide the basis for projection of certain phenomena in future. Since the SBCA is very much sensitive to the choice of data, unless a data-base is developed, it would be difficult to apply any of the sophisticated techniques of project appraisal in evaluation of a project. The project evaluator has to employ a variety of data sources and judgements about their accuracy and relevance. Particularly in case of a multi-purpose project, in which the economic benefits and costs involved are varied and complex, the measurement of net benefits necessitates a set of correct data. Moreover, in the case of a project like the RMP, which is under construction, the problem is not one of measuring the realised benefits and costs but one of forecasting the results of the investment in this project in the future and accordingly to estimate the benefits and costs. The projection of such conditions involves the attempt to build up as full a picture as possible of the conditions of economic activity in the project area. The framing of such a picture would be difficult without correct data of the past and present activities.

4.2 COLLECTION OF DATA:

To carry out the evaluation of the RMP a host of data has been needed for projection of the social benefits and costs both for the period of construction as well as the operation of the project. But it was not possible on our part to obtain all the data from any particular source or place. While the project reports were able to provide some technical data, they did not provide information on some other important points like the land use and cropping patterns in the flood-plain, the socio-economic indicators of the flood-plain and the detailed flood damages which had occured in different blocks, etc. All such data however are considered to be relevant for undertaking the SBCA of the RMP. Therefore, we have made an attempt to collect comprehensive data from different sources and places.

As such the data for the present study have been collected through field investigations by us. The wealth of data used in the study has been gathered from various sources on different field trips to Orissa. For the above purpose we have undertaken five different field trips, the duration of these being as follows: from 22.6.77 to 23.7.77, 31.10.77 to 25.12.77, 4.2.78 to 15.5.78, 25.6.79 to 10.7.79 and lastly from 25.10.79 to 5.11.79. Most of the data have been collected from the project authorities, the revenue authorities and the

officials of the community development and agricultural department, Govt. of Orissa.

4.3 METHODOLOGY ADOPTED:

The methodology adopted for collection of data has been to gather data from both secondary and primary sources. The secondary sources of information have been the Government files, where, most often the data were either overestimated or underestimated. To overcome these shortcomings in the available data, we decided to use our own judgement and also cross-examine the information collected from one source with the information collected from other sources. Accordingly necessary modifications have been introduced in the data. Further, with a view to obtaining data for projection of the indirect and secondary benefits, we have adopted a random sampling method of primary data collection through direct contact and open enquiry.

4.4 DATA FOR THE ESTIMATION OF DIRECT PRIMARY FLOOD CONTROL BENEFITS:

With regard to the estimation of the flood control benefits of the project, since the calculation of such benefits by the project authorities have been rejected by us on various grounds[22], we have to introduce a new method of estimating

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22. The various arguments advanced against the calculations of the project authorities are given in Annex.V/ Appendix 1.

such benefits. In order to proceed with our calculations we have collected the data from various sources and then used them after suitable modifications and adjustments.

4.4.1 DATA ON FLOOD DAMAGES & RELIEF:

Block-level data on flood damages and relief for different years used in our study have been collected from the district level offices, which generally keep the records of the extent of losses arising from floods incurred by various organizations operating under their control. The data base, their reporting systems, the drawbacks associated with them and also the modifications introduced by us in improving the data have been discussed below in detail.

(i) Data Base:

In Orissa, the Revenue Department publishes a "white paper on natural calamities", every year. This document contains details of the damages as well as the relief measures undertaken by the Government during floods, cyclone, draughts or tidal bores. This report is generally meant for the immediate reference of the state legislatures and, in most cases, is based on the preliminary reports of the Collectors of different affected districts. The data available in these reports are district-wise but not river-wise or basin-wise. Since we have been interested in finding out the flood damages

and the subsequent relief provided in the Brahmani flood-plain only, these reports were not of much use for our purpose. Then we have to turn our attention to the Collectors' final flood damage reports maintained by the Board of Revenue, Orissa, Cuttack. Again we have come across similar difficulties as the figures available were provided sub-division-wise whereas we needed the break up of figures by Development Blocks.

Thus, ultimately we had to go down to the district headquarters of the Brahmani flood-plain viz. Cuttack and Dhenkanal. And the block-level data needed for our analysis were collected from the District Emergency Offices of these two districts.

(ii) Reporting System:

In each district, the District Emergency office collects and compiles the data of damages and relief measures undertaken during a period of natural calamities. The District Emergency Officer is in charge of this office to help and coordinate the work of dispensing relief on behalf of the Collector of the district. Whenever some natural calamities occur within the district, the first hand information is collected at the Block/Tahasil level. The BDO/Tahasildar reports the damages to the Collector through his sub-divisional officer. In the case of floods, the BDO reports about the

population affected, the number of villages and area affected, the names of the rivers, streams or nullahs in spate that caused damages, the crop losses, the casualities (both human and bovine population) damages caused to Gram Panchayat (GP) and revenue roads, the number of private houses damaged, and finally the relief required. The primary reports are generally collected by the VLW (at present VAW) at the GP level and checked by the inspecting staff such as GPO, AEO, BDO, SDO, ADM or the Collector of the district. As most of this information is based on approximations owing to lack of suitable methodologies for measurement, either they are overestimated or underestimated.

In addition to this information, the Collector receives the reports of damages from the other district. level officers, who work within his jurisdiction. On the basis of these reports the Collector prepares a comprehensive flood damage report and submits it to the Government in two phases: one being preliminary and the other final. For our purpose we have concentrated our attention on the final reports of the Collector. But the data have been used by us after removing certain drawbacks in them.

(iii) Drawbacks of the Available Data:

In assessing the flood losses, sometimes the reporting officers have included the damages caused due to heavy rain

or cyclone into the category of flood damages. Most of the time the damages have not been segregated by them. This lacuna was revealed during our cross-examination of the data provided by the other district level officers to the Collector. An example may be given in this connection. In 1976 the number of primary and ME schools damaged in the Dhenkanal educational district was reported as 53; but on personal enquiry from the concerned officers in the field it was found that only 10 schools were affected by floods and others due to heavy rain or cyclonic wind. Similarly the verification of flood damage reports submitted by the Executive Engineers of RYB, REO and NH had also proved that only a few roads were damaged due to flood, comprising the roads within the flood prone area, and the rest were damaged either because of rains or cyclones or tidal waves.

(iv) Modifications Introduced in our Estimation:

Recognizing the possible drawbacks in the available data, we have introduced the following modifications in our calculation of net flood control benefits of the project:

(a) Crop Damage Estimation:

In the course of our field investigation it has been ascertained that whenever there are complete damages to Kharif crops due to floods, the farmers, in their turn, have

avoided the rest of the cultural practices (such as using fertilizers and harvesting operations, etc.). Thereby they have saved some recurring expenditures. Further, they have availed the opportunity of starting the Rabi cultivation a little earlier than in other years. Owing to the silting and improved moisture conditions after floods as well as the early operations of Rabi cultivation, the Rabi yields have increased in comparison to other years. In our attempt to arrive at the net crop damages due to floods, the above mentioned savings and the additional Rabi gains in income should be deducted from the gross crop damages during Kharif.

The adjustments as suggested above, were not being made either by the BDO or the DAO when they estimated the crop damage figures. However, in our attempt to estimate the net crop damages, we have first made an approximation[23] of the additional gains in Rabi crops due to floods and then deducted the same from the gross crop damage figures reported by the authorities.

(b) Road damage Estimation:

At the time of the occurence of floods and even after that the concerned authorities, who are in charge of the major

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23. The method of approximation is based on our discussions with the field official (AEOs or DAOs) and the farmers of the affected areas.

traffic roads, report the damages to roads to the Government either through the Collector of the district or through their respective Heads of Department. In their reports usually they demand money under the following three heads:

(i) The amount of money required for restoration of traffic;

(ii) The amount of money required to bring the road to pre-flood conditions; and

(iii) The amount of money required for permanent measures.

In our attempt to calculate the flood damages to roads, we have taken into account (i) and (ii) above because these are only attributable to flood losses. These expenses are also expected to be averted after the completion of the RMP.

On the other hand, with regard to the damages to REO roads, GP/Block roads, Revenue roads and Municipal/NAC roads, we have taken into consideration only the amount of money required for repairs to restore them to pre-flood conditions.

(c) Estimation of other Damages:

The damages reported by the Irrigation Department due to breaches or overtopping of the embankments have been taken as the amount of money required to restore them to their original positions; the damages to private houses and

Government buildings have been taken as the amount of money required for repairs to bring them to their previous conditions.

4.4.2 APPORTIONMENT OF DAMAGES:

Another important modification introduced by us relates to the apportionment of damages between different river systems. As explained in chapter II, the Brahmani flood-plain consists of 24 blocks, one municipality and 2 NACs. The block-level data that were available to us have proved that most of those blocks and municipality/NACs are also susceptible to floods from other river systems. Under the circumstance it would be incorrect to consider all the damages, reported by the BDO, as ascribable to the Brahmani system. Hence, there has been a need to prescribe a suitable method of apportionment of the flood damages between different river systems.

With regard to these apportionments, first of all we have tried to collect the percentage of damages caused by the Brahmani and its branches from the Irrigation Department, Govt. of Orissa. Although there exists a Flood Investigation Division in Orissa, which is supposed to collect all sorts of detailed data on floods and their damages, its officials could not supply any information to this effect. Failing this we attempted to collect this information from the District

Emergency Officers, but these attempts were also of no avail. Ultimately we collected the percentage of damages caused by the Brahmani system from the AEOs or GPOs of each affected block through personal enquiries.

4.5 DATA FOR ESTIMATION OF INDIRECT PRIMARY FLOOD CONTROL BENEFITS:

Although the completion of the RMP is likely to generate large varieties of indirect flood control benefits, the project authorities had hardly made any attempt to identify and quantify them. Further, owing to the complexities involved in their measurement, very few professional economists or Government agencies have attempted to estimate these benefits. However, in this study, we have made a beginning in this direction of developing a methodology for their measurement and quantification. Following our methodology, these benefits need to be forecast on a certain basis, and with a view to create such a base we have undertaken primary surveys in the control project area.

4.5.1 SELECTION OF THE CONTROL PROJECT:

The Hirakud Multi-purpose Project, across the Mahanadi in Orissa, has been selected by us as the control project for our analysis because of the following reasons.

(i) The major objectives of the Hirakud and the Rengali

multi-purpose projects are the same, i.e., flood control, power generation and irrigation;

(ii) both the projects are located in the same region of the country;

(iii) Hirakud being the first multi-purpose river valley project after independence has already been under operation for the last 23 years to provide good enough indicators for our projections;

(iv) the completion of the Hirakud project has not only brought relief to its extensive delta by protecting the people from flood hazards, but has at the same time, promoted significant all-round development in the Mahanadi flood-plain;

(v) the geographical and geological divisions of the flood-plains under the command of both the projects are more or less the identical. Moreover, major portions of the flood-plains are located in the adjacent areas of one district, namely, Cuttack; and

(vi) the socio-economic conditions, the people inhabiting the Brahmani flood-plain are comparable with the same prevailing in the Mahanadi flood-plain before the Hirakud project came in existence.

4.5.2 SELECTION OF THE SAMPLES:

The selection of samples for our primary survey has

been based on the geographical and geological characteristics of the flood-plain. The Mahanadi flood-plain may be broadly divided into:

(a) the valleys upto the head of the delta, i.e. the middle flood-plain;

(b) the alluvial plains, i.e., the lower flood-plain; and

(c) the littoral tracts, i.e. the lower most flood-plain.[24]

To provide a comparable base for our analysis, we have selected the samples from each part of the flood-plain. The selection of the sample blocks in each tract has been based on random sampling method with the ratio of 1:5. Accordingly, Athagarh and Narasingpur in the middle flood-plain, Raghunathpur and Nischintkoili in the lower flood-plain, and Kujanga in the lowermost flood-plain of the Mahanadi system have been selected as our sample blocks. The locations of these blocks are shown in Annex.II/Map 3. Then a few previously flood affected villages[25] from each selected block have been selected for collection of data on a random sample method, of course, in consultation with the AEOs of the concerned block.

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24. For detailed characteristics and descriptions of these divisions, See "Floods in Orissa Rivers", op. cit.

25. For names of the villages, see Annex.V(D)/Table No.30.

In addition to these data from the control project area, we had the opportunity of gathering some information on indirect flood control benefits of the Kosi Project in North Bihar,. Most of our results of the primary survey were empirically verified by us in the Kosi flood-plain during our field trip to the area.[26]

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26. In January 1979, the BCE, Patna had organized an "International workshop on Post-Fact Evaluation of a Water Resource Project (Case study-Kosi Project)". And as a part of the Workshop, they had arranged a field trip to the Kosi Project area and site to gain knowledge on the problem and suggest remedial measures to the Government". We had availed this opportunity to verify our results from the Mahanadi flood-plain.

CHAPTER V

THE PROJECT BENEFITS

(in terms of aggregate consumption objective)

5.1 THE CONCEPT OF BENEFIT:

Benefit usually refers to the direct and indirect marketed output of a project or the services provided by a project. In a planned economy the benefits flowing from any investment would be identified with reference to the broad national objectives of planning. Thus, in India it would be desirable that the value of any investment in the public sector should be measured in terms of its contribution to India's national planned objectives. Adhering to this approach of benefit measurement, in this chapter, we have attempted to estimate the contributions of the RMP in relation to the broad national goals embodied in the Fourth Five Year Plan of India. The major goals of the Fourth Plan of India. were:

(i) to raise the standard of living of the people through a higher level of consumption of goods and services (i.e., the aggregate consumption objective in our terminology);

(ii) to attain equity and social justice through rational distribution of added wealth between groups of people

(i.e., group income redistribution objective);

(iii) to correct regional imbalances by distribution of income between regions (i.e., regional redistribution objective);

(iv) to create additional employment opportunities (i.e., employment objective); and

(v) to achieve self-sufficiency in terms of reducing imports and increasing exports (i.e., self-sufficiency objective).

These above five objectives have provided the basis for our calculation of benefits from the different components of the project. In other words we have concentrated on relating the benefits from the project output to these objectives. The project output is to be understood in a wide sense of all output proposed to be produced by the project and its ancilliary activities which would not have been generated in the absence of the project.

5.1.1 The Classification of Benefits:

In SBCA it is customary to distinguish between the tangible and intangible benefits. The tangible benefits are those which can be measured in terms of money. The intangible benefits, on the other hand, are those which enter into the

individual's valuation but for which there is no market and hence, no market price. For example the tangible flood control benefits are those which are measurable in terms of money, viz., the recurring damages averted to crops, houses, public property and livestock, saving of resources, additional output produced from agricultural commercial and industrial activities, and the employment potentials created, etc. The intangible flood control benefits occur in the form of saving of human lives and physical safety in the flood-plain the peace of mind, avoidance of flood-borne diseases, improving environmental aesthetics and regional growth, etc. Even though these intangible benefits are important for social welfare, the quantitative measurement problems involved with them have forced us to neglect them in our calculations. These benefits have remained as non-economic in character. Therefore, the range of our inquiry in this study has been restricted to the tangible benefits relating to social welfare that which could be brought directly or indirectly within the perview of the measuring-rod of money. In Pigou's terminology this part of welfare is called the economic welfare[27]. These benefits are otherwise known as economic benefits.

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27. A.C. Pigou, "The Economics of Welfare", chapter I, Macmillan & Co. Ltd., London, 1952.

5.1.2 The Economic Benefits:

In this study, the following classification of economic benefits has been adopted by us.

(1) Primary benefits:

(a) Direct primary benefits, and

(b) Indirect primary benefits.

(2) Secondary benefits:

(a) Direct secondary benefits, and

(b) Indirect secondary benefits.

The conceptual basis of the above classification has been the chronological sequence of the occurrence of the benefits from the project and their cyclical behaviour.

PRIMARY BENEFITS:

The primary benefits, being the first round effects of the project, denote the value obtained from the project produced goods and services. The primary benefits from the project objectives are likely to occur immediately after the conclusion of the project's construction and continue throughout the lifespan of the project. Out of these benefits, the direct primary benefits are expected to flow immediately after the completion of the project and attain their peak

within 5-10 years[28] of the commencement of its operation. Whereas the indirect primary benefits would appear gradually and attain their stage of full development after 25 years of completion of the project. On the other hand, some of the primary benefits from the very construction works of the project would arise from the first year of the commencement of the project. These benefits are likely to attain their peak within 5-7 years of the construction and thereafter would continue to remain more or less stable during the rest of the period of construction. But after the completion of the project although these benefits would continue to occur, their value would be reduced. The examples of such benefits are: the growth of communication and transportation in the project area, growth of trade and commerce, and the development of other infrastructure , etc. These types of benefits, we have put under the category of "indirect primary benefits of the project", because they appear in the form of externalities.[29]

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28. Most of the projections of this kind relate to the project benefits flowing from a multi-purpose river valley project. These projections are based on our empirical verifications from the control project area.

29. The externalities are frequently referred to as external effects, neighbourhood effects. Spillovers, repercussion effects or even linkages. The externalities are said to exist whenever,
    (i) the economic activity in the form of production or consumption affects the production or utility levels of another producers or consumers or because of Government decisions;
    (ii) the effect is unpriced or uncompensated.

For these benefits the project authorities do not charge anything to the users of these facilities.

SECONDARY BENEFITS:

When the cycles of income and expenditure (generated in the form of primary benefits) are repeated in the economy, they give rise to a second set of consequences which are termed as secondary benefits. Thus, the secondary benefits occur during the second round cyclical occurrences of the project benefits.

The discussion of secondary benefits in recent times appears to have distinguished at least three varieties, viz., the customary variety of secondary benefits, secondary benefits due to external economies or diseconomies, and the dynamic or developmental secondary benefits.[30]

The customary variety of secondary benefits is perceived to arise from two sources. Firstly there are the effects termed as "stemming-from" which are generally attributed to the industries that supply the project area with goods and services. Secondly, the "induced effects", which are attributed to the industries that process, distribute

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30. For detailed discussion on these varieties, see, Allen V.Kneese, "Water Resource Development and Use", Federal Reserve Bank of Kansas City, 1972.

or consume the products of the project.

The second variety of possible secondary benefits grows out of the external economies or diseconomies of scale. The examples of such secondary benefits are the effects of the building up of social overhead capital, the expansion of markets in the sparsely populated or low income area, the division of labour, and the incidental pollution abatement from projects.

The third variety arises from the dynamic social engineering aspect of resource development. These benefits are based upon the development of more skilled labour, and the introduction of advanced techniques and capital, which would exploit the underutilized resources of the area to its optimal use. Sometimes these benefits are likely to arise from the migration of population within the country or from the policies of conservation of natural resources.

Although the occurrence of the above varieties of secondary benefits are conceptually clear, their measurement is still a problem for the project evaluator due to paucity of data. Hence, as a method of simplification, we have decided to examine the conventional varieties of secondary benefits in the form of direct secondary benefits and indirect secondary benefits. While the direct secondary benefits are expected to emanate from the effects of primary

benefits of the project either in the form of forward production linkages (stemming- from benefits) or in the form of backward production linkages (induced-by benefits); the indirect secondary benefits are likely to flow from the direct secondary benefits either through forward linkages or through backward linkages.

5.2 AGGREGATE CONSUMPTION BENEFITS:

Before going into the calculation of benefits of the RMP, let us briefly discuss the concept of aggregate consumption benefits and our preference for the same in the first instance. The project benefits which contribute to the crucial objective of planning, namely, improving the general standard of living of the people through higher level of consumption of material goods and services are termed as aggregate consumption benefits. These are the increments in consumption that a project provides, valued in terms of individual's ability to pay for the goods and services. In this study we have commenced with the calculations of project benefits in terms of this consumption objective (i.e., in terms of aggregate consumption gains) because of the following reasons:

(a) these benefits are normally the most crucial for the project choice;

(b) these benefits are the best measure of current welfare;

(c) these benefits are usually expressed in terms of additional economic goods and services, net of associated costs, which command a price in the market; hence, these benefits can be easily measured in terms of money; and

(d) these benefits are capable of reflecting the benefits flowing from other planned objectives (through weights in terms of consumption).

However, there are some measurement problems associated with the calculation of aggregate consumption benefits.[31] Generally the problems relate to (i) the aggregation of goods and services at a point of time, (ii) the aggregation of consumption over time, and (iii) the aggregation of consumption of different regions or groups of people. But to overcome these problems, we have attempted to introduce the shadow prices of goods and services, the social rate of discount and the premiums or weights for different regions or groups of people respectively.

With this brief discussion of the concept of benefits and their classification, and the importance of aggregate consumption benefits, we have proceeded below to calculate the benefits expected to flow from the RMP.

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31. For detailed discussions, see Guidelines, op. cit., pp.29-30.

5.3 FLOOD CONTROL BENEFITS OF THE PROJECT:

Since ensuring flood control benefits to the Brahmani flood-plain is the primary objective of the project, we have decided to start with the estimation of flood control benefits of the RMP.

5.3.1 Calculation of Flood Control Benefits by the Project Authorities:

Although flood control and power generation are the two objectives of the first stage of the project the CW& PC and Planning Commission, GOI, had accorded their approval of the project on the basis of its flood control benefits. The B-C ratio worked out by the project authorities was certainly very impressive. By a very crude method, the same was estimated at 2.2. To arrive at this rate, the project authorities had estimated the flood control benefits of the project by a method of apportionment of damages between different river systems and the same was calculated at Rs.6.65 crores per annum. In these calculations they had adopted the official methodology provided to them by the CW & PC. Our detailed examination of the methodology adopted by them as well as the calculation of benefits have shown that both the methodology and calculations suffer from a large number of drawbacks. Our comments on the same are provided in Annex V/ Appendix I,. Owing to the drawbacks associated with

the estimation of the project authorities, we have not accepted their calculation of flood control benefits.

5.3.2 Methods of Calculation of Flood Control Benefits in India:

In spite of the implementation of a number of flood contro projects in India after independence, no systematic efforts have yet been made in this country to develop any scientific method of calculation of flood control benefits. Very few professional economists have made an attempt to handle the complex problem of measurement of these benefits. The Government, in its turn, have also not taken any initiative to improve upon the methods of calculation of these benefits adopted by them. Hence, we have thought it proper to appraise the limitations associated with the methodologies prevailing in India.

THE OFFICIAL METHOD:

The official methods of estimation of flood control benefits of a multi-purpose river valley project were generally being provided by the CW & PC and the Central Board of Irrigation & Power, GOI. Since our detailed comments on the drawbacks associated with their methods are provided in Annex V/Appendix I, we are not to repeating them here.

THE METHODS ADOPTED BY THE NON-GOVT. ORGANIZATIONS:

With regard to the calculation of flood control benefits by the non-government organizations, we have come across only three studies in which an attempt is made to calculate these benefits. The persons or organizations, who had undertaken these studies are as follows:

(1) SOVANI & RATH:

Prof. Sovani and Rath[32] in their study, have attempted to provide a method of calculation of benefits flowing from the Hirakud multi-purpose project. Although they were able to estimate the direct and indirect benefits of irrigation, in case of flood control benefits they took into consideration the direct benefits only. In spite of their failure to quantify the indirect flood control benefits, however, it goes to their credit that they were in a position to identify the indirect benefits supposed to flow from the flood control objective of H the Hirakud project.

In their estimation of flood control benefits they first calculated the crop losses by taking into account three sets of conditions, namely, the area normally liable to floods, the area liable to fairly heavy floods, and the area liable to

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32. Prof. Sovani and Rath, op. cit.

abnormally heavy floods. Accordingly, they had estimated the average annual crop losses due to floods.

Then in arriving at the total flood losses they assumed that the losses other than crop damages such as damages to houses, livestocks, personal property roads and embankments, etc. would be 5% of the average crop losses.

Limitations: No doubt, the work of Prof. Sovani and Rath was of a pioneering nature. But we have observed the following limitations in their estimates.

First, in their calculations adequate care was not being taken to introduce any modification to the available data, i.e. the calculations were based on a weak data-base.

Secondly, their assumption of 5% of the crop losses as attributable to damages other than crops has turned out to be unrealistic. Our detailed calculations of the flood damages in the Brahmani flood-plain[33] has shown that the percentages of damages to crops varies between 75 to 80 per cent of the total flood losses, i.e. the damages to other items vary between 20 to 25 percent of the total losses.

Thirdly, in their calculations they did not include the damages to railways and other central government

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33. For our detailed calculations, see Annex V(C)/Table 27 and 28.

organizations, which also sustain damages during floods.

Fourthly, in computing the average crop losses, etc. they did not take into account the inflationary trend prevailing in the economy, i.e. the money values of losses for various years were not being deflated by a standard deflator.

Finally, they did not attempt to quantify the indirect flood control benefits which in our estimates for RMP have turned out to be quite significant.

(ii) NCAER:

In the early sixties the Ministry of Irrigation and Power, GOI, felt that in spite of the various commissions and Enquiry Committees set up by the Government from time to time to go into the problem of floods and their damages there was no scientific basis for the measurement of flood losses, and hence the flood control benefits. In view of this, in 1964 the Ministry gave a project to the NCAER to go into the problem of measurement of flood losses and to devise a suitable methodology. In response to the request of the Ministry the NCAER undertook some field investigation in the North Bihar regions and submitted the report entitled, "Scientific Assessment of Flood Damages" in 1968.

With regard to the methodology devised by the NCAER for the calculation of flood damages we would like to remark that the methodology was very scientific[34]. Particularly their method of calculation of indirect flood damages was superior to any other methodology available in this country.

But so far as the calculation of flood control benefits of a multi-purpose river valley project is concerned, their attempt had covered only a part of the actual benefits which are likely to accrue from the project. Their methodology was suitable only for the calculation of a part of the direct primary flood control benefits.

(iii) DASGUPTA & PEARCE:

Dasgupta and Pearce in their case study on "The Damodar Valley Flood Control Scheme"[35] had rejected the official approach of estimation of flood control benefits on various grounds. As an alternative to the official approach, they had developed a method of their own, viz., "Probability

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34. For detailed discussions, see, "Scientific Assessment of Flood Damages" NCAER, 1968.

35. A.K. Dasgupta and D.W. Pearce, "CBA: Theory and Practice, Chapter X", Macmillan, 1972.

Distribution of Peak Flow Method" with the assumption that flood damage was a function of the peakflow only.

But with regard to their method of estimation of benefits we feel that their method only provides a convenient first approximation because the level of damage also depends on various other considerations. Further, their method had not taken into account the indirect flood control benefits, which are quite important for a flood control project.

5.3.3 Our Methodology of Calculation of Flood Control Benefits:

On account of the drawbacks associated with the existing methodologies of calculation of flood control benefits in India, in this study we have made an attempt to develop a methodology for computation of these benefits in a comprehensive manner.

(i) The Steps Adopted:

In our methodology we have adopted the aforementioned four-fold classification of the economic benefits[36] and then expressed the benefits in relation to the objectives of economic planning in the country. In this chapter we have estimated the project benefits in terms of aggregate consumption

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36. A schematic diagram of the classification of the flood control benefits is provided in Annex V/Appendix II.

objective. The steps in our estimation are as follows. First of all, we have identified the different kinds of benefits that would flow from the project, and then we have grouped them as per our classification of economic benefits providing justification for the same. Next, we have computed the "net output" expected to flow from the different components of the project. After computing the "net output", we have made an attempt to find a suitable measure for the aggregation of the benefits at a point of time. The prices of the goods and services in terms of "consumers" willingness to pay"[37] have provided us with the measure. However, whenever there were some discrepancies between the market prices and the "consumers' willingness to pay", we have decided to estimate the "shadow prices" or "accounting prices" for the relevant output of the project.

(ii) <u>The net output and Prices</u>:

The "net output" in our analysis has been ascertained as the additions to supply, which would not have been possible in the absence of the project, but not substitutes for supply.

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37. The concept of "willingness to pay" was first developed by Jules Dupuit (1844). He recognised among other things the existing consumers' surplus and proposed that benefits to the community from public enterprises like bridges and roads are not the revenues generated to the public treasury, the actual payments of the public, but the public willingness to pay, that is, the sum of actual payments and consumers' surplus.

The major output of the project would consist of the final consumers' goods and producers' goods. Further, most of the final consumers' goods of the project are ascertained to be the additional agricultural products like paddy, wheat, pulses, jute, vegetables and fish, etc. But as we know, the market prices of these products are very close to competitive prices. Secondly, there is no strict rationing, nor there is any monopoly power exercised by any consumer of these products in the market. Thirdly, it is envisaged that the additional total supply due to the project would not bring about any significant change in the market prices. On account of these factors we have boldly assumed that the market prices of these products would approximately reflect the "consumers' willingness to pay", and hence, the appropriate "shadow prices" for the project's agricultural output. Therefore, the market prices of these output at the base year level have been used by us as a rough measure of the consumers' willingness to pay.

On the other hand, another important output of the project, namely, electricity is both a consumers' good as well as a producers' good. The prices of electricity in India are almost invariably administered prices. Further, there is a monopoly power in the hands of the Government in relation to its supply. Thus, it is normally expected that

the market prices do not reflect the users (consumers) willingness to pay. This necessitates the determination of the shadow price of electricity. But in the absence of adequate data for the estimation of shadow prices we have resorted to a method of approximation in the form of a "weight" and that weight has been used by us in estimating the market prices.

DIRECT PRIMARY FLOOD CONTROL BENEFITS:

The primary flood control benefits of the project are the first round effects which would flow directly or indirectly in the form of (i) the recurring damages averted and the adjustment costs saved, (ii) additional agricultural output generated in the flood-plain, and (iii) the consequent benefits flowing from the reservoir and embankments, created for flood control. Normally these benefits would accrue from the physical effects of the project on the users of goods and services. While (i) and (iii) constitute the direct primary flood control benefits in our terminology, the (ii) would be an important constituent of the indirect flood control benefits.

The direct primary flood control benefits of the project are expected to occur immediately after the project is completed. These benefits are likely to accrue to the people and institutions, which are directly affected by floods.

Besides, another section of the population and institution would be benefited from the big reservoir and the embankments created for flood control. For the sake of simplicity, we have divided these benefits into three kinds:

(a) Reservoir benefits,

(b) Embankment benefits, and

(c) Damage aversion benefits.

(a) Reservoir Benefits:

The big reservoir proposed to be constructed for impounding the flood waters would provide potential for fish and wildlife development as well as tourism development. Moreover, consequent upon the fall in the reservoir level in slack seasons there would be opportunities for cultivation of the lands in the periphery of the reservoir. The net "value added" by the exploitation of each of these potentials created would comprise the direct primary benefits attributable to the project.

In order to estimate these benefits in terms of our unit of measurement (i.e., in terms of the base year's aggregate consumption level), we have, first of all, attempted to measure the benefits from the potential fisheries development in the reservoir area. On the basis of our data, collected from the Fisheries Research Station at Hirakud and

the Fisheries Department officials of the Government of Orissa, we have projected that the fisheries potentials of the reservoir area would be nearly 20 kg. per hectare with some regular investment and 8-10 kg. per hectare without any investment.[38] But with little conservatism we have assumed that the average net yield of fish per hectare would be nearly 6 kg. without any investment and 10 kg. with investment. Secondly, we have assumed that in spite of the possibilities in fluctuations in the yield rates, these average yield rates would prevail throughout the lifespan of the project. Further from the project authorities we have collected the information on the reservoir area. Nearly one lakh acres of land would come under water by the reservoir after the completion of the project. With these piece of information and the assumptions we have estimated that the net value added from the fisheries development would be approximately 2400 quintals of fish without any investment and 4000 quintals with certain investment by the Government. Then with the help of the base year market price of Rs.500 per quintal of fish, we have converted these net value added figures into monetary terms. Accordingly the benefits from fisheries development would be approximately Rs.12 lakhs per annum without any

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38. This information is based on the fisheries potential development in the Hirakud reservoir area.

investment and Rs.20 lakhs with investment.

Secondly, with regard to the wildlife development, we have projected that with the existing development patterns in Orissa, there would be no scope for wildlife development in the reservoir area. That too, since we have visualised for fisheries development in future, any wildlife development scheme would defeat the former objective.

Thirdly, with respect to recreation development, we have projected that although a potential would be created, its net contribution in terms of "value added" to national income would be insignificant or even nil.

Fourthly, with regard to the calculation of additional gains from the agricultural development (possibly to be undertaken) in the periphery lands of the reservoir we have projected that at least 10,000 acres of cultivable area, which is half of the total area supposed to be released in the slack season, would be available during the Rabi and Summer seasons. With this information from the project authorities we have attempted to calculate the benefits from the cultivable lands and for this purpose we have adopted the following simplifications[39], viz.; (i) at least, a single

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39. These simplifications have been developed by us on the basis of our data from the Hirakud reservoir area as well as our discussions with the field officials.

crop would be grown in the periphery areas; (ii) the general cropping pattern envisaged as that nearly 50% of this land would be covered with Dalua (local) and HYV paddy and the rest 50% would be covered with vegetables or pulses like mung, biri (blackgram), etc.

Then we have derived the per acre average net benefit figures for different crops by imputation. In 1978, the per acre net benefits from paddy cultivation was nearly Rs.1,000 and for pulses and vegetables it was nearly Rs.600. When these figures were deflated by us (with 8% standard deflator)[40] to the base year (1973) level, we obtained the per acre net benefits as Rs.680/- and Rs.480/- respectively.

On the basis of these results and our simplifications, the net benefits from paddy cultivation in the reservoir area is valued at nearly Rs.34.0 lakhs per annum and the same from pulses and vegetables is valued at Rs.20.4 lakhs per annum approximately. Thus, the total benefits from the agricultural operations in the periphery reservoir area would be Rs.54.4 lakhs per annum approximately.

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40. This standard deflator is based on the average inflationary rate of 8%, which has been estimated to be prevailed in India during the last two decades.

(b) Embankment Benefits:

In most of the flood control projects, strengthening of the existing embankments or construction of new embankments with suitable flood gates and road above them for flood fighting becomes inevitable to ensure full flood protection. These roads above the embankments which would connect the interior areas to the developed areas, would also facilitate the marketing of agricultural inputs and outputs. Further, these roads would provide cheaper and easy transportation facilities to the people in the flood-plain. The net "value added" by these roads, measured in terms of "willingness to pay" by the users of the facilities minus the cost of supply, should be treated as direct primary benefit of the project.

But unfortunately, due to the paucity of data in this regard, we have neglected these benefits in our estimates.

(c) Damage Aversion Benefits:

The potential gains likely to accrue to the society from the aversion of recurring flood damages in the flood-plain have been included in this category. These gains are expected to flow directly from the use of the services provided by the project. In respect of the unit of measurement of these benefits, we have assumed that people would be willing to pay, at least, as much as the value of losses that

would have been sustained by them in the absence of the project. Hence, the average losses likely to be prevented, measured at the base year price level have provided us with the unit of measurement for computation of such benefits.

In our analysis these benefits comprise the direct physical damages to property, indirect damages to agricultural, industrial and commercial activities, indirect damages to communication and transportation systems, and the adjustment costs involved in providing emergency services before, during and after the floods.

(1) Direct Damages:

Generally the direct physical damages from floods occur either through overflow actions or backwater actions of flood waters. These damages include, inter alia, the following class of property damages, which sustain losses due to the direct touch of flood waters, namely;

(a) damages to crops,

(b) damages to private houses,

(c) damages to livestocks,

(d) damages to roads and public works facilities,

(e) damages to communication systems,

(f) damages to major transport systems,

(g) damages to forestry and fishing, and

(h) damages to industries in the flood-plain.

However, in our calculation of direct damages, the last two classes of property damages have been neglected because they were not found to be significant in the Brahmani flood-plain. But to estimate the physical damages to other items we have collected the time series data from different sources. Since the sources used by us have already been elaborated in the preceding chapter, we may now explain our methodology and approach of calculation of these benefits.

First of all, with a view to compute the net crop losses[41] due to floods we have collected the data on the total cultivated area affected and the loss of yields in quintals of paddy. These data were available at the block level. But in most cases these loss figures were not expressed in monetary terms. Hence, we have converted them into monetary terms by using the wholesale market prices of paddy, collected from the Market Intelligence Section of the Food and Civil Supplies Department, Govt. of Orissa. On the basis of our assumption that a certain percentage of gross crop losses would be recovered as the additional gains during Rabi season, we have subtracted these additional gains from the gross crop losses and finally arrived at the net crop losses occurring

41. The net crop losses due to floods have constituted nearly 75 to 80 percent of the total flood losses in the Brahmani flood-plain.

to the society from the ravages of floods. These net crop loss figures for different years and for different blocks in the Brahmani flood-plain are provided in column 19 of tables 1-24/ Annex V.

Secondly, in respect of the damages to private houses, we have collected the data on the number of private houses affected by floods and their valuations at market prices as provided by the authorities. Thirdly, in respect of the damages to livestock, we have got the data on their casualties and their valuations at market prices. In the event of the non-availability of money values, we made the relevant estimates with the help of current market prices. Fourthly, in respect of the damages to GP & Samiti roads, minor irrigation projects, NAC/ Municipal and public works facilities, we used the official data with some minor modifications. The total losses to the above items are given in Tables 1-24/ Annex V.

Lastly, in respect of the calculation of direct damages to the Central Government organizations, which operate in the Brahmani flood-plain, we have collected the relevent data from railways, national highways and posts and telegraph department, Govt. of India. The damage and loss figures to each of these organizations for different years have been provided in table 26/Annex V.

In addition to these above varieties of property damages, another form of direct damage caused by floods has been identified, namely, the damages to cultivable land from sand-casting. Sometimes also it is argued that the benefits flowing from the control of sand-casting should be included in the form of damage aversion benefits. But we have rejected this argument on the following grounds. First, flood waters also deposit silts in the vicinity of the river and thereby enrich the fertility of lands. The productivity of lands increases due to this silt deposit. Since this positive effect of silt deposit would counteract the negative effects of sand-casting, we have neglected both the effects in our calculation of direct flood damages. Secondly, as both these effects have already been taken care of in the calculation of net crop losses, their inclusion would have amounted to double counting.

(2) Indirect Damages:

The losses arising out of the effects of floods may cause interruptions in normal social and economic activities in the region in particular and the whole nation in general. Like disruption of the communication and transportation systems, inability to perform routine agricultural, industrial and commercial activities and the non-availability of services

due to floods, may result in loss of earnings and incomes not only in the area flooded but outside too. The losses from these effects have been classified as indirect flood damages. A few examples of such losses may be cited as: losses incurred by food-processing industries due to crop damages; losses incurred by the industries due to non-availability of raw materials owing to traffic disruption; loss of revenues to transport sectors; and loss of earning to wage labourers.

However, all these losses are likely to be short lived. There is also every likelihood that the above mentioned activities would step up their production processes once the flood waters receded and communications are restored. Even for the wage labourers, lots of job opportunities would be created after the floods by which they could compensate their losses. In addition, some of the losses in the flood-plain may be off-set by expanded production elsewhere in the economy. Thus, in our opinion, the net indirect damages would not be very significant as compared with the magnitude of direct flood damages. Furthermore, the constraints of data availability to introduce such sophistications into the calculations, have forced us to neglect these indirect flood damages. Notwithstanding these limitations, in case of the damages to railways these indirect losses have been included

because the railway authorities could provide us the desired data.

(3) Adjustment Costs: (relief, grants and loans)

The protection from flood hazards requires adequate emergency and flood fighting measures. In order to minimise the magnitude of losses, the Governments normally take some emergency actions before, during and after the floods. Moreover, to tide over the temporary disequilibrium, the Government further provide grants and loans to the affected persons. In addition to these Governmental measures, other voluntary non-official organizations also promptly come forward to undertake relief measures in the flood afflicted areas. All these expenses attributable to floods are termed as adjustment costs. These costs, among other things, include the emergency expenses like: (a) evacuation of persons and property in advance of floods and subsequent reoccupations; (b) flood fighting, (c) disaster relief, (d) increased cost of continuing normal operations during floods, and (e) miscellaneous emergency services such as increased police and army patrol.

It is expected that the completion of the RMP would ensure full flood control in the Brahmani flood-plain. This guarantee from floods, in its turn, would result in saving of the expenses on emergency and restoration actions; hence,

the adjustment costs would constitute a part of project benefits. But in our opinion these adjustment costs should not be considered as part of project benefits because these are simply the "transfer payments" in the economy. In this regard we can point out that it is well articulated in the SBCA that transfer payments do not constitute a part of the benefit from the point of view of aggregate consumption objective. Since we have adopted aggregate consumption gains as the unit of measurement for calculating the project benefits, we have dropped these "adjustment costs" in our calculations.

The calculations of the "damage aversion benefits" have been synthesised in the following table:

Table 1 : ESTIMATES OF DAMAGE AVERSION BENEFITS OF THE RMP

(Figures in lakh Rs.)

Sl.No.	Area/organization expected to be benefited	Net benefits at market prices	Net benefits at base year prices.
1.	Av. property losses proposed to be saved in Cuttack dist.	234.09	222.65
2.	Av. property losses proposed to be saved in Dhenkanal dist.	25.29	23.13
3.	Av. losses proposed to be saved to central Govt. organizations operating in the Brahmani flood-plain.	10.33	8.98
	Total	269.71	254.76

The results incorporated in the table above have been derived from our calculations provided in tables 1-28/Annex V.

However, one should note at this stage that these average damage aversion benefits would be achieved only when there would be 100% flood protection. Hence, the next important question arises- to what extent the project could provide guarantee from floods? As the project authorities could not provide any convincing answer to this question, we had to resort to a method of empirical verification, in which we examined the extent to which Hirakud dam has prevented losses in the Mahanadi flood-plain. Our primary survey results which are given in table 29/Annex V(D) have proved that within 1-5, 6-15 and 16-25 years of completion of the project, the cultivated area affected has been 5.29% and 2.12% of the previously affected areas respectively. With these results as the base we have projected that within 1-5, 6-15 and 16- 25 years of completion of the RMP the percentage of losses would be 5%, 2.5% and 2% of the average flood losses respectively.

Further, we have assumed that even after the peak stage of the project, the flood losses would continue to be 2% of the average current losses because there may not be 100% flood protection. Although there is every possibility that the flood control capacity of the project would deteriorate further after 50 years due to heavy siltation in the reservoir

area, we have not attempted to estimate the benefits beyond 50 years in order to avoid uncertanties in the project output. In accordance with these assumptions our projected damage aversion benefits per annum at base year price level would be approximately Rs.242.02 lakhs between 1983-88, Rs.248.39 lakhs between 1988-1998 and Rs.249.66 lakhs between 1998-2008 and the rest.

DIRECT PRIMARY FLOOD CONTROL BENEFITS: SUMMED UP:

To sum up the calculations of direct primary flood control benefits for the project, we have prepared the following table.

Table 2 : PROJECTED DIRECT PRIMARY FLOOD CONTROL BENEFITS OF THE RMP (in terms of aggregate consumption)

(Figures in lakh Rs.)

Sl. No.	Nature & source of benefits	Net benefits per annum at base yr.prices			
		1983-88	1988-98	1998-2008	2008-onwards
1.	Reservoir Benefits:				
	a) Fisheries Dev.	12.00 (20.00)	12.00 (20.00)	12.00 (20.00)	12.00 (20.00)
	b) Wildlife Dev.	-	-	-	-
	c) Recreation Dev.	-	-	-	-
	d) Agr. dev. in the Reservoir area.	54.40	54.40	54.40	54.40
2.	Embankment Benefits	Negl.	Negl.	Negl.	Negl.
3.	Damage Aversion Bene.	242.02	248.39	249.66	249.66
	Total	308.42	314.79	316.06	316.06

Note: Fig.within brackets are the net benefit figures with investment for fisheries development.

The above table shows the annual direct primary flood control benefits for various years at base year price levels. Within 1983-1988, the total additional benefits generated in the economy would be Rs.308.42 lakhs under the assumption of no additional investment in fisheries development. In case there would be some investment for exploitation of the additional fisheries potentials, these benefits would go upto Rs.316.42 lakhs. Ultimately from 1998-2008 and above these benefits would be Rs.316.06 lakhs per annum at base year price levels without any investment in fisheries development.

INDIRECT PRIMARY FLOOD CONTROL BENEFITS:

In this section we have attempted to define the indirect benefits in terms of externalities. The indirect primary benefits ascribable to the project would be the consequent effects flowing through externalities for which no payments would be made by the users. These benefits are likely to occur when individuals start realizing the economic consequences of technological external effects.[42] Further, these effects would result either from production of project output or services or from its use by others.

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42. The technological external effects or physical externalities occur when the production function of the affected producer or the utility function of the affected consumer is altered due to physical interaction.

Moreover, it is well recognised that in case of a multi-purpose river valley project the presence of externalities is widespread. More particularly, their presence would be pronounced if there is flood control objective. The RMP is likely to provide means to particular economic and social ends in an indirect way, and these means, in their turn, would give rise to indirect benefits which would occur due to the following external impacts; viz.,

(i) additional agricultural operations,
(ii) increased land values,
(iii) extension of drinking water facilities,
(iv) extension of navigation facilities,
(v) additional fish and wildlife development, and
(vi) saving of transportation and construction costs.

(i) <u>Benefits from Additional Agricultural Operations</u>:

The construction of the RMP accompanied by strong embankments and flood-gates would not only provide guarantee against recurring crop damages, but would also ensure certainity for agricultural operations in the flood-plain. Further, the regulated and continuous flow of water in the river would enhance the irrigation potentials in the vicinity of the river. Hence, it is generally expected that the farmers would try to reclaim the sub-marginal lands (namely,

sand-casted, water-logged and saline affected), which were abandoned for cultivation purposes owing to higher cost of cultivation. In other words the sand-casted, water-logged and saline affected lands are likely to come under cultivation because the net gains from these lands would be positive. Moreover, the additional savings generated due to the protection of physical property would induce the farmers for reinvestment of funds for agricultural development. Apart from these follow-up actions by the farmers themselves, the agricultural supporting and extension services provided by the Governments as well as the extension of credit facilities by the banking and financial institutions would provide incentives to the farmers to reclaim the sub-marginal lands, and thereby the area under cultivation would be enhanced.

In short, we can say that the RMP is likely to create additional opportunities for the best utilization of land and thereby generate additional agricultural output in its flood-plain due to the following reasons.

(a) enhanced area under cultivation,

(b) growth of irrigation potentials,

(c) changing cropping patterns, and

(d) improved methods of cultivation.

cultivation has increased over the years in the Mahanadi flood-plain. Assuming the area cultivated in the base year (i.e. 1955) to be 100%, this figure in the lower and lowermost flood-plain has gone upto 126.14% in 1960, 143.2% in 1970 and 167.1% in 1977; and in the middle flood-plain it has gone upto 131.10%, 152.10% and 188.5% in the respective years. With these results as our base we have assumed that ultimately the additional area reclaimable in the middle flood-plain and lower flood-plain of the Brahmani system would be 75% and 60% respectively. These assumptions in respect of the reclamation of cultivable lands along with detailed break up for reclamation of sand-casted as well as water-logged areas during different time periods and for different segments of the flood-plain are given in table 33/Annex V. While the reclamation of sand-casted areas in the upper most flood-plain would be 60% of the flood affected areas after 25 years, the same would be 15% in the lowermost flood-plain. Similarly with regard to the reclamation of water-logged areas it is further assumed that the ultimate reclamation in the upper-most portion would be 15% whereas in the lowermost portion it would be 45% of the cultivated area affected by floods.

On the basis of these assumptions we have estimated the additional area expected to be reclaimed by the maturity stage of the project. The block-wise detail figures are given

in table 34/Annex V(E). The table also shows the sand-casted and water-logged areas expected to be reclaimed in different years in different blocks of the flood-plain. By this method it is estimated that the total cultivable area to be reclaimed in the flood-plain after 25 years of the completion of the project would be 2,08,232 acreas (1,21,695 acres water-logged and 86,537 acres sand-casted). Within the various segments of the flood-plain, the middle portion of the lower flood-plain would reclaim the maximum cultivable area i.e. 80,186 acres and the upper portion of the middle flood-plain the lowest, i.e., 10,575 acres.

Next, we have projected the net benefits to be accrued from these above reclaimable cultivable lands. In order to calculate these benefits in monetary terms, we have further relied on our primary survey data, collected from our sample blocks of the Mahanadi flood-plain. In table 31/Annex V(D), we have reported the cropping patterns, yield rates and the net income generated per acre per crop for different years in the sample blocks. The results in the table have revealed that there have been significant changes in the cropping patterns, yield rates and in the net income generated per acre. The blocks in the lower flood-plain which were sustaining heavy losses before the construction of the Hirakud dam have achieved the maximum benefits in terms of

additional agricultural output. Nevertheless, each block in the flood-plain has been benefited in terms of additional net gains from the cultivable lands. In table 32/Annex V(D), the net income generated per acre under irrigated and non-irrigated conditions from 1955 to 1977 have been given. On the basis of these net gain figures we have calculated the net income figures expected to flow to the society from the reclamation of sub-marginal lands in the Brahmani flood-plain. In table 35/Annex V(E) we have provided these net gains expected to flow to the society at the base year prices. These net benefit figures have been worked out for different portions of the flood-plain and also for different time periods. Although these benefit figures are likely to increase over the years, as a method of simplification we have projected same trend of development for the periods from 1983-88, then another increased trend for 1988-1998, and a third increased trend for 1998-2008.

Simultaneously we have incorporated the additional gains that would flow from irrigation development in the flood-plain[43]. It is normally expected that owing to regulated

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43. With regard to the irrigation development, we have adopted a very bold assumption that the benefits from irrigation are attributable to flood control because we have envisaged that without flood control no irrigation is possible in the flood-plain.

and continuous flow of water in the river throughout the year there would be development of lift irrigation facilities in the adjacent areas of the river. The continuous flow of water would also enhance the ground water potentials in the flood-plain, which would be exploited through dug-well systems or by other methods of lift irrigation. But the irrigation potentials would vary from one portion of the flood-plain to another. In this regard we have assumed that the ultimate irrigation development would be 25,30,45,45 and 30 percent of the additional cultivable area in the upper and lower portion of the middle flood-plain respectively. These assumptions are based on our knowledge gained from the control project area. Of course, these assumptions may change due to the increased emphasis placed on irrigation development through various national plans.

With these sets of assumptions we have calculated the net gains from the reclamation of cultivable land in the Brahmani flood-plain. These net benefit figures in different time periods and for different segments of the flood-plain at the base year price levels are given in column (5) of table 35/Annex V(F). This column also indicates the benefits from development of irrigation potential in the flood-plain.

(b) Additional Benefits from the present Cultivated Area:

With respect to the impact of the project on the present cultivated area in the flood-plain, we have envisaged that since there would be changes in the cropping patterns and further improvements in the methods of cultivation, some additional net output would be generated. This would happen because the security from floods might provide incentives to the farmers either to go for high yielding varieties of cultivation or to improved methods with the existing cultivation standards. Our survey results, provided in table 30 & 31/Annex V(D), have proved that the number and variety of crops grown and the net benefits from cultivation in the Mahanadi flood-plain have improved significantly after the completion of the Hirakud project. With the help of these indicators we have calculated the net benefits likely to occur from the present cultivated lands in the Brahmani flood-plain. Our projected estimations are given in table 36/Annex V(E). However, with regard to these projections we have adopted the following assumptions: (i) that there would be full development of these cultivated lands within 15 years of the completion of the project, hence, the additional net income figures per acre have been computed with the sixties standard of the control project as the base, (ii) that the development of irrigation within these 15 years would be, at least 25% of

the cultivated area for the entire flood-plain except the middle portion of the lower flood-plain. In the latter segment it would be 30%.

The net gains for different segments of the flood-plain and for different time periods are given in column (4) of table 36/Annex V(E) at the base year price levels.

In table 37/Annex V(E) we have furnished the projected indirect primary benefit figures expected to flow from additional agricultural operations in the Brahmani flood-plain after completion of the Rengali project. The figures show the net benefits at base year price levels for different time periods and for different segments of the flood-plain. As per these calculations between 1983-88 these indirect benefits per annum would amount to Rs.1,043.25 lakhs at base year price levels. While within 1988-1998, these benefits per annum would be Rs.2,697.42 lakhs at base year price levels, within 1998-2008, these figures would increase upto Rs.4,180.63 lakhs. Beyond 2008 till the lifespan of the project, these benefits have been assumed to be the same.

(ii) Benefits from Increased Land Values:

As a result of the security from flood losses to crops, sand-casting, water-logging and from salinity, it is expected that the land values in the flood-plain (both in

real and monetary terms) would gradually increase. Furthermore, the consequent rise in productivity of land would also enhance the land values. These increased land values are likely to form a part of indirect benefits of the project because they would be accrued by the farmers without making any payment to the project authorities. But since this sort of benefit has already been taken care of by (i) above in terms of aggregate consumption objectives, we have decided to drop them from our calculation to avoid double counting.

(iii) <u>Benefits from Extension of Drinking water Facilities</u>:

The regulated and assured flow of water in the river, the consequent reduction in salinity in the down stream and the growth of ground water potentials would provide opportunities for drinking water facilities to villages, municipalities or towns and industries in the flood-plain. As such these facilities provide direct consumption gains and hence, should be measured in terms of 'willingness to pay' by the users of these facilities.

In case of the Rengali project there is every possibility that the drinking water facilities would be extended to the villages in the vicinity of the river during the summer season and also to the townships like Talcher, Dhenkanal, Bhuban, Jajpur Road and Pattamundai. But the

non-availability of adequate data in this regard has compelled us to drop these benefits from our calculations.

(iv) Benefits from Extension of Navigation Facilities:

Owing to the continuous flow of water in the main river and its branches throughout the year, some additional navigation potential would be generated in the hinterlands. The "value added"[44] by additional navigation opportunities may be assignable to the project. But with respect to the RMP, we have projected that the net gains from these potentials would be insignificant because of stiff competition from road transport. Besides, there is no important industrial or commercial centre located in this flood-plain (nor there is any possibility of growth) which would utilize the navigation potentials generated by the project. For these reasons we have neglected these benefits in our calculation.

(v) Benefits from Additional Fish & Wildlife Development:

The increased flow of water and the extension of the sweet water belt in the river would ensure better opportunities

44. The "value added" is defined as the value of the final product minus the value of the material inputs purchased by the producer (material inputs include raw materials, intermediate inputs, fuel, supplies and utilities such as water and electricity, but excludes capital equipment). In other words, it is the value that has been added by the labour and capital employed by the producer.

for fish and wildlife development. Particularly, the down stream part would be more suitable for wildlife like crocodiles. The net "value added" by these additional fish and wildlife development are considered as the indirect benefits of the project. However, in case of the Rengali project, we have predicted that there would be hardly any additional net "value added" from these potentials which would be taken into consideration as part of indirect benefits of the project. Hence, these benefits have also been neglected in our calculations of indirect benefits.

(vi) Benefits from Saving of Transportation & Construction Costs:

Any flood control project is likely to save indirectly the costs of local transport because the insurance from flood hazards would provide opportunities for expansion of cheap transport facilities in the flood-plain and thereby minimise the transport costs of the people. Further, the project may save some construction costs of railways and roadways as there would be no need to raise them to flood heights.

These savings would be, at least, equal to the indirect damages of roadways and railways, and since these damage figures have already been taken into account in our earlier calculation of direct primary benefits we have decided

to neglect them in this section. That too, these benefits would not be very significant in the future years.

The foregoing discussions and calculations have proved that among the indirect primary flood control benefits, the benefits from additional agricultural operations are most important and prominent. The other indirect benefits are relevant but not very significant; hence, they are neglected in our calculations.

DIRECT & INDIRECT PRIMARY FLOOD CONTROL BENEFITS: SUMMED UP

To highlight the magnitude of direct and indirect primary flood control benefits in different years, we have synthesised our detailed calculations in the following table:

Table 3 : PROJECTED DIRECT & INDIRECT PRIMARY FLOOD CONTROL BENEFITS OF THE RMP

(Figures in lakh Rs.)

Sl. No.	Nature of benefits	Net benefits per annum at base year prices			
		1983-88	1988-98	1998-2008	2008-onwards
1.	Direct primary benefits	308.42	314.79	316.06	316.06
2.	Indirect primary benefits	1043.25	2697.42	4180.63	4180.63
	Total	1351.67	3012.21	4496.69	4496.69

The above table shows that the primary flood control benefits of the project per annum during the initial periods would be nearly Rs.1,351.67 lakhs, of which the indirect benefits would be approximately Rs.1,043.25 lakhs. By the time the project attains its maturity stage, these primary benefits would go upto Rs.4,496.69 lakhs with Rs.4,180.63 as indirect benefits. The table further shows that while both kinds of benefits have increased over the years, the rate of increase with respect to the indirect benefits has became very high. Whereas the indirect benefits in the initial years would be more than 3 times of the direct benefits, they would be nearly 13 times at the stage of maturity and afterwards.

The above results have proved that the indirect primary flood control benefits would be much more significant in comparison to the direct primary flood control benefits of a multi-purpose project. However, these indirect primary flood control benefits have been always neglected by the project authorities as well as by the CWC and Planning Commission, Govt. of India. Thus, on the basis of these results we would like to develop the hypothesis that the indirect primary flood control benefits of a multi-purpose project are significant and prominent and hence, ought to be considered seriously in the evaluation of such projects.

SECONDARY FLOOD CONTROL BENEFITS:

In section 5.1.2 we have already mentioned about the types of secondary benefits and our approach in measuring such benefits. Accordingly we have adopted a two-fold classification of the conventional types of secondary benefits, viz., direct and indirect secondary benefits.

(i) Direct Secondary Benefits:

These benefits are likely to flow from the primary flood control benefits. Generally these benefits would occur along with the primary benefits but they would achieve significance after the peak period of direct primary flood control benefits, i.e. after 5 years of the completion of the project. These benefits would either 'stem-from' or be 'induced-by' the primary benefits in the form of backward production linkages or forward production linkages respectively. The saving of physical property, the greater economic activities undertaken in the flood-plain would result in increased incomes which would be partly saved or partly consumed. Thus, there would be increased demand for both consumer's and producers' goods or services. In their turn, the consumers' goods industries would step up their production activities in the flood-plain or outside. These activities would generate benefits like additional incomes and additional employment opportunities,

which are termed as direct secondary benefits of the project. The examples of these benefits may be cited as follows: due to additional agricultural operations in the flood-plain, the industries like sugar, jute, food processing, rice haulers, or oil crushers (forward linkage effects) may come up or extend their production activities. Further, the additional agricultural operations and the improved agricultural practices may provide incentives to sectors like fertilizers, pesticides or machinery (backward linkage effects) to expand their production. Moreover, sectors like transport, tertiary, trade and commerce would be developed due to the primary benefits of flood control and are expected to generate additional incomes in the economy. Theoretically, the additional "value added" by all these sectors should be treated as project benefits in the second round.

(ii) Indirect Secondary Benefits:

The impacts of direct secondary benefits would flow in the form of indirect secondary benefits either through 'forward linkages' or through 'backward linkages'. The examples of such benefits are: the additional production activities in sectors like sugar, jute, food-processing, fertilizers and pesticides, rice haulers, etc. would require more of machinaries and machine parts and also other raw

materials. The sectors supplying these machinery machine parts and raw materials, in their turn, would step up their production activities. These additional production activities would generate some "net value" in terms of consumption benefits. These additional gains, known as indirect secondary benefits, may be assigned to the project benefits.

(iii) The Measurement Problems Involved:

Even though the occurrence of these secondary benefits of flood control are conceptually simple and clear, there are severe measurement problems owing to: (a) lack of adequate data, (b) identification of the linkages associated with the primary benefits and (c) difficulties in attribution of the benefits to flood control. Sometimes the growth of the secondary sector might have been possible due to the development activities undertaken by the Government in the flood-plain.

To get over problems such as these, it is suggested that the consumption multiplier approach may be adopted. But in this context Marglin[45] has suggested that the secondary consumption created through multiplier by the expenditures of the project users is not to be counted as a benefit from the point of view of aggregate consumption objective because

45. Stephen Marglin, op. cit.

it is assumed that a corresponding multiplier chain would result from investment elsewhere in the economy.

(iv) Our Estimations:

In addition to the above weaknesses as regards the system of measurement, we would like to mention further that a part of these secondary benefits have already been taken care of in our calculation of indirect primary benefits. Furthermore, our survey results in the control project area have indicated that there have been no significant development of secondary sectors in the Mahanadi flood-plain.

Hence, for all these reasons we have restrained ourselves from attempting to measure the secondary flood control benefits of the Rengali project.

5.4 POWER GENERATION BENEFITS OF THE PROJECT:

The power generation aspect of the Rengali project as envisaged in its project report comprises an installed capacity of 100 MW at the initial years and 200 MW ultimately. But since detailed technical calculations as well as the year of operation, etc. with respect to 4 x 50 MW of ultimate installed capacity are not available in the project report, we have decided to concentrate our estimation on the proposed installed capacity of 100 MW, with this much of installed

capacity, it is estimated that the net firm energy available would be 523 million KWH and the secondary energy generation would be 146 million KWH. Further, it is proposed that with the commissioning of the Koel-karo project in Bihar, the net firm energy available would be 631.8 M. KWH and the secondary energy generation would be 60 M. KWH. We have attempted below to calculate the benefits (of course primary benefits only) from these power generations; first on the basis of the engineering methodology, and, secondly on the basis of our own methodology.

5.4.1 <u>Calculations by the Engineering Methodology</u>:

Generally, the power engineers calculate the benefits from power generation of a multi-purpose river valley project on the basis alternative costs of energy generation i.e. saving in costs. They calculate the per unit cost of power generation from the hydrosystem and then compare it with the alternative source of power generation i.e. the thermal system. The difference between these costs, provides them the per unit benefit from energy.

The latest cost estimation of the Rengali power project stands at approximately 10 paisa per unit of energy, whereas the corresponding cost from thermal power in Orissa is around 15 paisa. Hence, the per unit benefit from the energy amounts

to 5 paisa for the Rengali project. Adhering to this methodology of calculation, the amount of benefit from power generation would be nearly Rs.261.5 lakhs per annum from 1983 - 1988 and Rs. 316.0 lakhs from 1988 onwards.

But this method of estimation has failed to reflect the benefits in terms of the 'value added' in the economy, which is supposed to represent the aggregate consumption objective of national planning.

5.4.2 Calculations by Our Methodology:

We have attempted to express these primary power generation benefits in terms of "value added", measured by the consumers' "willingness to pay" rather than what they actually pay in the market. Ordinarily the users 'willingness to pay' for power can be taken as a measure of the contribution of power to aggregate consumption.

In order to calculate the 'value added' from power generation we have adopted some methods of approximation. By this method, the gross value added by power generation would be the benefits accruing to society from its consumption. The steps of our calculation of these benefits are as follows:

First of all, we have allocated the net firm energy expected to be available from 1983 between different sectors of the economy, i.e., between those which use power either for

consumption purposes or for production purposes. The allocation for 1983-85 has been based on the projected consumption patterns of the OSEB[46] for the year 1982-83. On the basis of their percentage of allocation we have estimated the firm energy that would be available to each consuming sector. The results show that out of 5,230 lakh KWH of projected net firm energy available from the project, the industries only would consume about 4,826 lakh KWH (i.e. 92.28 percent) and the rest would flow to other consuming sectors. The projected absolute energy figures likely to be available to each sector, along with their percentages for different years are given in table 38/Annex V(F). Similarly for 1985-86 we have allocated the energy on the basis of the consumption patterns of 1983-84.

Secondly, we have assumed that, at least, by 1988, the Koel-Karo project in Bihar would be commissioned; thus the potential net firm energy available would be raised to 6,320 lakh KWH. We have allocated this energy between different sectors on the basis of our projection of the distribution pattern that would prevail from 1988 onwards. This projection of ours is based on the past and projected consumption trends upto 1984-85 and also on the trend of development activities

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46. See, "Growth of Energy Sales and System Demand" by the Orissa state Electricity Board (OSEB), submitted to the CEA, 1976-77, provided in Annex II/Appendix II/Table 8.

expected to be undertaken in the future years. Accordingly the projected absolute energy figures for different sectors have been calculated by us and the results are provided in column (5) of table 38/Annex V(F). Furthermore, we have assumed that this consumption pattern would continue for the rest part of the project life.

Thirdly, we have assumed that each consuming sector would, at least, derive benefits to the extent it would be "willing to pay" the prices for its use. This approximately would measure the 'value added' to that sector. Hence, the maximum potential tariff rates, which the users are willing to part for using power, for each sets of consumers at the base year level (i.e. 1973-74 price level) have been used by us in calculating the gross value added by power. By the help of the maximum tariff rates, which each sector is willing to pay, we have calculated the money value of energy in different sectors for different time periods. The total value of money they would be paying for the use of energy would roughly measure the "value added" by power in the respective sectors. These money values for each sector are given in columns (7), (8) and (9) of table 39/Annex V(F). By adding these money values we have arrived at the "value added" figures for power generation, which would be Rs.700.12 lakhs per annum from 1983-1985, Rs.708.34 lakhs from 1985-88

and Rs.859.84 lakhs per annum from 1988 onwards.

But as we know, in a developing country like India where the market prices of commodities like power and irrigation are administered prices, it is generally expected that there market prices would be lower than the competitive market prices. These prices are not the equilibrium prices which would reflect the true value of commodities. Thus, the prices offered in the market are not good indicators of social welfare. Under these circumstances, the "willingness to pay" would usually exceed the actual payments for the output. Therefore, there is a need to use the "shadow prices" of energy.

Owing to lack of adequate data for the estimation of "shadow prices", we have followed a method of approximation in the form of a "weight" . This weight has been derived from the conversion factors, used by the World Bank[47] in evaluating the medium irrigation projects in Orissa. The World Bank has computed a 60% conversion factor to be used for all non-traded commodities. Since electricity is considered as a non-traded commodity, we have used the above conversion factor as the weight for imputing the benefits of

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47. World Bank, "India: Appraisal of the Orissa Irrigation Project", South Asia Projects Department, Agriculture Division C, August, 1977.

power generation. With the help of this weight we have recalculated the benefits, which would be Rs.1166.85 lakhs, Rs.1180.57 lakhs and Rs.1433.07 lakhs per annum from 1983-85, 1985-88 and 1988 onwards respectively.

5.5 INDIRECT PRIMARY BENEFITS OF THE PROJECT:

Generally it is observed that some indirect benefits, associated with the project, are likely to flow from the very process of commencement of the construction works. However, their occurrences would be prominent from the second and third year of project construction. While some of these benefits are expected to continue to occur till the lifespan of the project, some of them would be reduced with the completion of the project construction.

These benefits are expected to flow from the following facilities created by the project:

(i) development of communication facilities in the project area;

(ii) construction of buildings (residential and non-residential);

(iii) development of transport facilities;

(iv) growth of trade and marketing facilities;

(v) development of 'social overhead' like schools, hospitals, banks, post offices, etc.

The benefits from the above facilities are expected to flow to the users in the form of externalities, for which the project authorities do not charge any price.

5.5.1 Benefits from Communication Development:

The site of the Rengali project is located in one of the backward areas of a backward district, namely, Dhenkanal. The area did not have any access roads during the rainy season because there were no bridges nor culverts on the hill streams and small rivers. But the commencement of the construction of the Rengali project has opened up easy communication opportunities in the area. Thereby, the people of the nearby villages have been benefited. Since the project has proposed to invest Rs.120 lakhs on these developments, we have attempted below to calculate the indirect benefits to be generated out of them.

In this regard Prof. Sen & Choudhury[48] have proposed that a perpetual return of 15% on the value of investment on buildings, roads and culverts should be taken as net indirect benefits from these facilities. Following their estimates we have calculated the indirect benefits from the growth of

48. Prof. A.K. Sen & Mrinal Datta Choudhury, "An Economic Evaluation of the Durgapur Fertilizer Project: A Case Study from India", Indian Economic Review, 1970.

communication systems in the project area, i.e. the indirect benefits from investment on roads, bridges and culverts have been computed with 15% rate of return. Firstly, we have calculated the year-wise and cumulative investment figures. Then with the help of 15% rate of return as the indirect benefit from these investment, we have estimated the net benefit figures. With regard to the continuation of these benefits we have assumed that even when the project would be completed, these roads would persist with their accompanying benefits. Thus, the indirect benefits from the communication systems would continue to occur throughout the lifespan of the project.

5.5.2 Benefits from Buildings:

The RMP proposes to invest Rs.200 lakhs for construction of residential and non-residential buildings. Certainly these structures would bring some benefits to the employees of the project. Following Sen's argument we have assumed a 15% perpetual return on these facilities. The indirect benefits from the roads and buildings are provided in column (6) of table 40/Annex V.

5.5.3 Benefits from Transportation Development:

The development of roads and communication systems as well as the growth of markets have opened up opportunities for

transportation development to the area. In our judgement, the additional "value added" by these transport services should be considered as the indirect benefits of the project. We have tried below to calculate the contribution of these transport services.

In order to compute these benefits we have collected data for various years on the number of buses plying in between the project site and other places. The data is provided in columns (7) and (8) of table 40/Annex V. The data has shown that while there was no bus service available to the project site in 1972-73, it has gone up from 2 in 1973-74 to 11 during 1978-79. Then we have approximated that the "value added" per bus at 1973 level was roughly Rs.30,000 per annum.[49] Further, we have assumed that the development of the transport system reached its peak during 1978-79 and these services would continue till the completion of the project. However, after the completion of the project, since the demand for transport would be reduced, we have assumed to this effect that the transport service requirements would come down to 1976-77 level.

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49. These figures are ascertained on the basis of our discussions with the transport owners, who are operating the transport services to the Rengali project site.

With these sets of assumptions, we have estimated the net 'value added' by the transport development. These results are given in column (9) of table 40/Annex V. These indirect benefits, which amounted to Rs.0.60 lakhs in 1973-74 have gone upto Rs.2.70 lakhs per annum from 1978-79 till 1983. After the completion of the construction as these services would be reduced, the indirect benefits per annum would be Rs.1.65 lakhs.

5.5.4 Benefits from Growth of Trade & Marketing Facilities:

Any multi-purpose river valley project is expected to provide large scale employment opportunities (both skilled and unskilled). Persons from the other project areas as well as from the nearby areas are likely to come over to the project site in search of jobs. The large number of employment opportunities so created (both for establishment and construction), in their turn, are likely to raise the purchasing power in the hands of the people. Thus, there will be growing demand for goods and services. These demands, accompanied by the development of communication and transportation systems will provide ample opportunities for growth of marketing facilities in the project area. Traders, hoteliers, businessmen and other kinds of shop keepers are expected to come over to the project area and exploit the trading and marketing facilities. These

service sectors, on the other hand, are likely to add to the national income in terms of net 'value added'. Moreover, we would like to emphasise at this point that these net 'value added' by the services sector should be attributable to the project, because these benefits would not have been accrued to the society in the absence of this project. Therefore, we have attempted below to estimate these benefits for the Rengali project.

Before the construction of the Rengali project, there was no shop in the project area. Gradually the number of shops in the area has gone up, while in 1972-73, there was not a single shop, in 1973-74 their number was roughly 10. But by 1978-79 the same figure has gone upto roughly 200. The approximate numbers in different years as well as their projected numbers are given in column (10) of table 40/Annex V. At present there are different kinds of shops in the project area, starting from pan shops to hotels, cloth and medicine stores. Although different kinds of shops' contribution to the national income in terms of "value added" would be different, we have assumed for the sake of simplicity that on an average each shop might be contributing Rs.3,000 per annum to national income. Further, we have assumed that the number of these shops would be reduced to half of its peak size after the completion of the project.

On the basis of these assumptions we have computed the indirect benefits from the growth of trade and marketing facilities in the project area. These figures are provided in column (11) of table 40/Annex V. The results have shown that while the annual indirect benefits from these facilities were Rs.0.30 lakhs in 1973-74 the same had gone upto Rs.6.00 lakhs during 1978-79.

However, after the completion of the project, these benefits would be reduced to Rs.7 lakhs per annum.

5.5.5 Benefits from "Social overheads" Development:

In addition to the above mentioned facilities, the construction of the RMP has also provided opportunities for development of social overheads like banks, hospitals, schools, post offices, etc. in the project area. But since these facilities have both the cost and benefit components, the benefits and costs of these investment are likely to cancel out each other. Hence, the benefits flowing from these facilities are not being considered by us in our calculations.

5.5.6 Indirect Benefits: Summed up:

We have estimated above the indirect benefits, that would accrue to the society from the construction of the project, which would not have come up in the absence of the

project. These benefit figures, provided in table 40/Annex V, have shown that the contribution of project created facilities like communication and buildings is the highest among all the indirect benefits. These benefits have slowly moved up, attained their peak after five years of the commencement of the construction works and then remained stagnant upto the completion of the project. However, these have declined after the completion of the project, but not significantly. While at the peak stage of construction the indirect benefits of the project construction have been estimated at Rs.56.70 lakhs per annum, after the completion of the project, the same would fall to Rs.52.65 lakhs per annum for the lifespan of the project.

5.6 SUMMING UP OF THE PROJECT BENEFITS: (in terms of aggregate consumption objective):

The estimates of the different kinds of benefits expected to flow from the RMP in different years are summarised in the following table:

Table 4: PROJECTED DIRECT & INDIRECT BENEFITS OF THE RMP

(Figures in lakh Rs.)

Sl. No.	Years	Benefits from flood control		Power generation benefits	Indirect primary benefits	Total benefits
		Direct	Indirect			
(1)	(2)	(3)	(4)	(5)	(6)	(7)
1.	1973-74	-	-	-	8.56	8.56
2.	1974-75	-	-	-	22.19	22.19
3.	1975-76	-	-	-	30.61	30.61
4.	1976-77	-	-	-	43.35	43.35
5.	1977-78	-	-	-	56.70	56.70
6.	1978-79 to 1982-83	-	-	-	56.70	56.70
7.	1983-84 to 1984-85	308.42	1043.25	1166.85	52.65	2571.17
8.	1985-86 to 1987-88	308.42	1043.25	1180.57	52.65	2584.89
9.	1988-89 to 1997-98	314.79	2697.42	1433.07	52.65	4497.93
10.	1998-99 to 2007-08	316.06	4180.63	1433.07	52.65	5982.41
11.	2008-09 onwards	316.06	4180.63	1433.07	52.65	5982.41

Note: - These benefit figures are expressed in terms of their shadow prices.

Our results in the above table indicate that among the project objectives (or components) namely, flood control and power generation, the benefits flowing from flood control have always exceeded the benefits from power generation. Of course, in terms of direct benefits the power generation benefits are always far ahead of the flood control benefits. Furthermore, the indirect flood control benefits, which have been neglected by the project authorities, have

proved to be much more prominent and significant. These benefits are likely to increase gradually and attain the peak after 25 years of the operation of the project.

CHAPTER VI

THE PROJECT BENEFITS
(in terms of other national planned objectives)

6.1 INTRODUCTION:

The analysis so far has proceeded in calculating the project benefits in terms of aggregate consumption under the assumption that the changes in the national income resulting from the implementation of the RHP to different regions or groups of income recipients are given equal weights. Following the Guidelines as also other approaches to project evaluation it would be desirable to make adjustments in the calculations on the basis of income distribution considerations and the effect of the project on different regions and different groups of people, etc. Hence, in this chapter an attempt is made to introduce the other objectives of planning in the calculation of project benefits.

6.2 BENEFITS IN TERMS OF GROUP INCOME REDISTRIBUTION:

The second objective of the Fourth Five-Year Plan of India, as mentioned in the preceding chapter, was to attain equity and social justice through rational distribution of added wealth between groups of people, i.e., to attain group income redistribution. Generally it is advocated in the existing literature on project evaluation that a premium,

determined at the national level, should be applied to consumption gains accruing to the preferred groups of beneficiaries in order to account for the redistributional gains in the calculations of aggregate consumption benefits. But owing to the limitations arising from paucity of data we have been forced to neglect this objective. First, with respect to flood control benefits we have been unable to classify the beneficiaries into different income groups because no data was available to this effect. Secondly, with regard to benefits of power generation although we have identified the separate groups of people to whom the benefits will flow in future, the absence of readily available weights to be assigned to these different groups have restrained us from correcting our estimates of project benefits from the viewpoint of group redistributional gains.

6.3 BENEFITS IN TERMS OF REGIONAL INCOME REDISTRIBUTION:

Another broad goal of planning in India is "to correct regional imbalances by distribution of income between regions, i.e., to pursue regional redistribution objective." This objective too needs a premium or weight to be used and the value of the premium should be supplied by the central planners to the project evaluator.

When a premium is being placed for any region, the goal or objective function of the project plan formulation in the public sector would be:

$$\text{Max} \left\{ (\text{Net aggregation consumption gains}) + \lambda\,(\text{net gains of the backward region}) \right\},$$

where λ is the premium placed on the backward region[50]. In the last chapter we have estimated the net aggregate consumption gains which would be split into different regional gains. Next question then arises what would be the value of λ ?

6.3.1 Estimation of Value of λ for the Project:

Particularly in the absence of any specific value of λ, we have adopted the following method of approximation for calculating the value of this said premium. In the specification of the central planners Orissa is recognised as a backward region[51], and hence the Government of India provides a subsidy of 15% for the development of any industrial project in this region. We have decided to use this percentage as the value of λ for regional income redistribution. Thus, 15% is the general premium that has been used by us in calculating the

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50. See, Stephen Marglin, op. cit.

51. To this effect see, the economic indicators of Orissa, provided in Annex II/Appendix II.

project benefits in terms of regional redistribution.

However, we have identified further that there are still some differences in the backwardness within the project region. The project region of the RMP consists of areas of Cuttack, Dhenkanal and Sambalpur districts. In the judgement of the Government of Orissa, Dhenkanal and Sambalpur (particularly the portion of Deogarh subdivision that which would come under the reservoir) are considered as backward areas. So the Government of Orissa in addition to the subsidy provided by the Government of India provides another 10% subsidy for the development of any industrial projects in Dhenkanal and Sambalpur areas. In otherwords, the industrial projects in Dhenkanal and Sambalpur areas get a subsidy of 25%. Thus, for the calculation of benefits and costs generated in these areas, we have decided to use a premium of 25%, that which would take care of regional redistribution.

6.3.2 The Estimates:

In accordance with our discussions above we have used a premium of 15% on the flood control benefits (both direct and indirect) expected to be generated within the 16 blocks of Cuttack district in the Brahmani flood-plain and a 25% premium for the 8 blocks of Dhenkanal district. Further we know that the direct benefits from the additional agricultural

operations in the periphery reservoir area, and the fisheries development in the reservoir and also the indirect benefits from project construction, would be generated in Dhenkanal and Sambalpur areas, which are still backward in the specification of the Government of Orissa. Hence, a premium of 25% has been used on these benefits to take care of regional redistribution of benefits. On the other hand, with regard to the power generation benefits we have failed to identify its regional use because the power lines from the project would be connected to the State's major power grids and once these powers are connected to the grid system it would be difficult to know their distribution patterns on regional basis. However, as a measure of simplification we have assumed that the additional power expected to be generated from the RMP would be consumed within Orissa. Thus, a general premium of 15% has been used on these benefits.

Accordingly we have calculated the project benefits in terms of regional redistribution objective. These corrected estimates of consumption benefits after application of premiums for regional redistribution effects are provided in the following table:

Table 5: CORRECTED ESTIMATES OF CONSUMPTION BENEFITS OF THE RMP AFTER APPLYING THE PREMIUMS FOR REGIONAL REDISTRIBUTION EFFECTS:

(Figures in lakh Rs.)

Sl. No.	Year	Benefits from flood control		Power generation benefits	Indirect benefits	Total benefits
		Direct	Indirect			
(1)	(2)	(3)	(4)	(5)	(6)	(7)
1.	1973-74	-	-	-	10.70	10.70
2.	1974-75	-	-	-	27.70	27.70
3.	1975-76	-	-	-	38.26	38.26
4.	1976-77	-	-	-	54.19	54.19
5.	1977-78	-	-	-	70.87	70.87
6.	1978-79 to 1982-83	-	-	-	70.87	70.87
7.	1983-84 to 1984-85	362.24	1211.79	1341.88	65.81	2981.72
8.	1985-86 to 1987-88	362.24	1211.79	1357.65	65.81	2997.49
9.	1988-89 to 1997-98	369.59	3129.93	1648.03	65.81	5213.36
10.	1998-99 to 2007-08	371.05	4853.38	1648.03	65.81	6938.27
11.	2008-09 onwards	371.05	4853.38	1648.03	65.81	6938.27

Note:- The figures in columns (3) to (6) are the adjusted figures obtained after application of weights to the respective columns in table 4/chapter V.

The above table shows that after introduction of the regional income redistribution objective into our calculations, the potential benefits expected to flow from the RMP have improved significantly. A comparison between the above table and table 4/chapter V has revealed the magnitude of improvements in the project benefits. While the total benefits in terms of aggregate consumption have been estimated at Rs.2571.17 lakhs from 1983-85, the same have been gone up to Rs.2981.72 lakhs after applying the premiums for regional income redistribution. Similarly the total benefits from 2008-09 onwards have been estimated at Rs.6938.27 lakhs in terms of regional redistribution in place of Rs.5982.41 lakhs in terms of aggregate consumption only.

6.4 BENEFITS IN TERMS OF EMPLOYMENT GENERATION:

Another important objective of the Fourth plan was to create additional employment opportunities. An expansion of employment level or more specifically a reduction of unemployment is usually treated as a good thing because it provides opportunities for the labour (i) to maintain his expertise; (ii) to use the national resources efficiently, (iii) to protect labours' self dignity and social status in the society, (iv) to reduce lawlessness and misery in the society, and further (v) to reduce maldistribution of income

and consumption in the economy. Furthermore, if more employment opportunities are created, their contributions would add to national income and hence, to consumption.

Of course, the RMP, being labour intensive in character, has created large number of employment opportunities for both skilled and unskilled categories of labour. But as we know that the benefits from these additional employment generations have already been taken care of in the aggregate consumption objective, we have decided to neglect them in our calculation. Moreover, in all likelihood, the employment objective does not so much represent a separate objective in itself. Rather it is treated as a means for generating benefits under other objectives.[52] That too the introduction of shadow prices in cost calculations would, to some extent, reflect the benefits from this objective.

6.5 BENEFITS IN TERMS OF SELF-RELIANCE:

Usually this kind of benefit is expressed in terms of the impact of the project on import and export of the country. In a developing country like India where foreign exchange plays a dominant role, the net impact of any project

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52. For detailed discussions on this point see, Guidelines, op. cit., p.88 and p.98.

should be determined not only in terms of domestic availability of goods and services but on the market for foreign exchange. This would be the case when the project involved the production of goods and services which are tradeable in the international market, i.e. when the goods and services produced by the project are either export- oriented or substitutes for imports. Sometimes also export and import substitution may be attained indirectly if the project releases goods from an alternative source of supply, and those goods are then used to increase exports or save imports. In either case, the objective is to attain self-sufficiency in foreign exchange reserves.

However, the goods and services to be produced by the RMP would not satisfy any one of the above conditions. The goods and services produced from the two major objectives, viz., flood control and power generation would be non-tradeable in the international markets hence, the project's contribution to the promotion of exports or import substitution objective would be practically nil. Of course, there may be some indirect impacts, but these may be neglected by us. Moreover, we have accepted the justifications provided in the guidelines in this respect, i.e., "the availability of foreign exchange is desired not for its own sake but for the sake of other objectives, e.g., aggregate consumption, to which it contributes.

In this view foreign exchange is not something that makes people happier directly; it is a means to other ends."[53] For these reasons we have neglected the objective of self-sufficiency in our calculations.[54]

Thus, in this study the group income redistribution, employment and self-sufficiency objectives are not directly reflected in the calculation of project benefits. These objectives have been considered as derived objectives only.

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53. Guidelines, op. cit., p.103.

54. This also provides the base to neglect the determination of shadow price of foreign exchange in the next chapter.

CHAPTER VII

THE PROJECT COSTS

7.1 THE CONCEPT OF COSTS:

From the accounting viewpoint, costs refer to payment of any amount for anything, but from the viewpoint of the society as a whole, costs are sacrificed benefits. The meaning of costs, like the meaning of benefits, depends on the national objectives. As benefits measure the contribution of a programme to an objective of the national plan, so also costs measure the extent to which activities that the programme displaces elsewhere in the economy would contribute to the objective. Looked at from this angle the costs are described as "opportunity costs" which would indicate the maximum benefit that would have been derived by following an alternative decision. Thus, the costs entail the sacrifices with respect to the objectives of national planning. In chapter V we have already mentioned the broad goals of the Fourth Five Year Plan with respect to which the costs of the project will be measured.

Moreover, these costs are to be expressed in terms of "net inputs" which are defined as the goods and services withdrawn from the rest of the economy that would not have been withdrawn in the absence of the project.

7.2 THE FINANCIAL COSTS OF THE PROJECT:

The investment costs involved in the RMP can be broadly devided into; the costs for construction of dam and appurtnent works, costs for construction of embankments and the costs for installation of the power project. These costs would be incurred during the period of construction, i.e. from 1973-74 to 1982-83. In addition to these investment costs, operation and maintenance costs (O & M costs) would occur after the completion of these project components.

7.2.1 The costs of Dam and Appurtnent Works:

The dam and appurtnent works constitute the unit I of the RMP. Although the initial estimate of the investment costs at 1972 price level was Rs.4126.66 lakhs, by 1976 the same was revised to Rs.7500 lakhs due to cost escalations and higher compensations for acquiring the reservoir area. In our calculation of the SBCA we have used the latest investment cost estimate available to us, i.e. Rs.7500 lakhs.

The investment costs of the dam and appurtnent works include, inter alia, the direct charges under the heads: A- preliminary, B- land, C- works, K- buildings, M- plantation, O- miscellaneous, P- maintenance, Q - special T & P, and R- communications[55]. However, for our convenience of

55. The initials like A,B,C,K,M,O,P,Q and R are the conventional sub-heads used in the project report.

calculations we have put all these costs into six broad categories; namely, the costs of civil works, costs of machinery and equipment, costs of land, costs of project facilities, costs of management and the costs of other items of work.

(i) The Cost of Civil Works:

The various major items of civil works are excavation, mesonary dam, power dam, spillway, training wall, diversion and dykes. These works involve 4,68,481 cum. of excavation, 5,27,500 cum. of masonary 2,53,000 cum. of concreting, 5,505 sq. m. of gates, 10,600 cum. of training walls, 81,450 cum. of diversion channel, 1,72,133 cum. of coffer dam and 5,000 sq. m. of pitching and turfing for the dykes. The total investment cost involved in these works has been estimated at Rs.3,301.47 lakhs (i.e. 44.22% of the total costs of unit I).

(ii) The cost of Machinery & Equipment:

The investment costs of machinery and equipment include the costs of procuring special tools and plants required for civil works. The gross expenses on these items have been estimated to be Rs.140.97 lakhs, out of which Rs.99.04 lakhs would be recovered after the completion of the project. Hence,

the net expenses on them would be Rs.41.93 lakhs.

(iii) The Costs of Land:

The construction of RMP requires a huge amount of land particularly for the reservoir and civil works. It has been estimated that 1,02,318 acres of land are required for the reservoir and 1,550 acres for the civil works. Further, 11,012 families consisting of about 55,000 persons from 262 villages are to be resettled and rehabilitated in some model villages before the completion of the project. Accordingly, the costs of acquiring land have been divided into two groups, namely, the costs involved in acquisition of land and property, and the costs incurred on rehabilitation and reclamation[56]. While the initial investment costs on these were estimated at Rs.1528.53 lakhs, in the revised estimate of 1976 these costs have gone upto Rs.2716.39 lakhs (which is 36.22% of the dam and appurtnent costs). The increase is accounted for by higher compensation payments to the losers and liberal rehabilitation policies adopted by the Government. However, in the subsequent years it has again been proposed that these costs would be Rs.3275.87 lakhs[57]. But since these proposals

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56. For greater details of these costs, see, Rengali Multi-purpose Project, revised estimate, 'B-land, prepared by the Chief Construction Engineer, RMP, 1977.

57. See the proposals in the above mentioned report.

are not yet approved by the Government, we have decided to take into account the approved costs only.

Out of the approved costs of Rs.2716.39 lakhs, Rs.1509.44 lakhs have been earmarked for acquisition of land and Rs.1206.95 lakhs for rehabilitation and reclamation. The outlay under land acquisition has further been splitted into three categories, namely, (a) land acquisition for the reservoir, (b) land acquisition for works and (c) costs of compensation for various properties and structures like houses, tanks, wells, standing crops, orchards, trades, etc. On the basis of the latest revised estimates, 66.44% of the costs of land acquisition would go for (a) and (b) and 33.56% for (c).

(iv) <u>The Costs of Project Facilities</u>:

The execution of the project necessitates the extension of certain project facilities like roads and buildings. As per the project requirements 60 KMs. of preliminary and access roads (pucca road), 587 numbers of residential buildings for the employees, and 37 non-residential buildings for office and other purposes are to be constructed. It is further envisaged that even after the completion of the project the roads and building structures would continue operating for the lifespan of the project. Only some temporary

structures would be dismantled. The investment costs involved in construction of roads and other communication systems have been estimated at Rs.120 lakhs (as against Rs.112 lakhs in the initial estimate). On the other hand, the investment costs for construction of buildings have been estimated at Rs. 200 lakhs (as against Rs.139 lakhs in the initial estimate).

(v) The Costs of Management of Establishment:

In the initial project report, the costs of establishment were estimated to be 8% over costs of unit I, excluding B-land. Accordingly, these costs were estimated at Rs.193.55 lakhs. But later on, in the revised estimate these costs have been approximated at 8% of the costs of unit I, including B- land. Hence, in the revised estimate the costs of establishment have been calculated to be Rs.556 lakhs.

(vi) The Costs on other Items of Work:

In this category we have included the costs involved in A- preliminary, O- miscellaneous, P- maintenance, M- plantation, ordinary tools and plants, and suspense, etc. The total costs involved on these items have been worked out to be Rs.564.21 lakhs.

The detailed cost calculations of these items (i) to (vi) above have been provided in table 1 & 2 /Annex VII.

However, a word of caution is needed at this stage. The figures provided in table 2/Annex VII are the money values of each year expressed in terms of their respective market prices upto 1976-77 and the rest are the projected figures at 1976-77 price levels. But as mentioned earlier, we have selected the year 1973-74 as the base year for the project. Hence there is an urgent need to bring about adjustments in the different values to the base year level. Adhering to our earlier assumption of 8% inflationary rate, we have suitably converted the values for different years into the base year level. These adjusted values are being provided in row (8) of table 2/Annex VII. When we have adjusted these values to the base year level, the total costs for dam and appurtnent works have been reduced to Rs.6060 lakhs from Rs.7500 lakhs. In our estimation of the SBCA of the project, we have used these adjusted values rather than the market values for different years.

7.2.2 The Costs of Embankments:

In order to ensure flood control in the Brahmani flood-plain, in the 1972-73 project report it was estimated that Rs.1500 lakhs would be required for strengthening the existing

embankments and also for construction of new embankments and flood gates at proper places. Following these proposals, the I & P Dept., Govt. of Orissa had already submitted a plan proposal for the approval of the Planning Commission, GOI. In the course of our discussions with the project authorities we were informed that at least, by 1982 this proposal would be approved. Hence, we have assumed in our estimation that the construction of embankments would commence from 1983-84, after the completion of the dam and appurtnent works and further, that work on these embankments would be completed within 5 years, i.e. by 1987-88.

With regard to the costs of these embankments we have accepted the earlier estimate of Rs.1500 lakhs. Moreover, we have decided to use these figures without any price adjustment to the base year level and also with the assumption that an equal amount of money would be invested in each year. Following these assumptions, a sum of Rs.300 lakhs per annum would be invested on construction of embankments and other related works from 1983-84 to 1987-88. These initial cost figures along with the O & M costs for different years are given in table 4/Annex VII.

7.2.3 The Costs of Power Generation:

The 100 MW capacity of hydro-power installation of the project constitutes the unit III of the RIP. While in

1972 the costs required for installation of the power project were estimated to be Rs.1600.08 lakhs, in 1976 the costs have been revised to Rs.2400 lakhs. The major components of the power project are the construction of power house, the special tools and plants and the works items like (a) generating plant and auxiliary equipment, (b) switch-gear, control and instruments and switch yard, (c) miscellaneous electrical equipment and construction facilities, and (d) other works. But for the sake of convenience in making calculations we have divided these components of power costs into six categories, viz., the costs involved in the construction of the power house, costs of generating plant and machinery, costs of tools and plants, the costs of buildings, costs of management and the receipts and recoveries[58]. In the revised estimate the costs for construction of the power house have been raised from Rs.330 lakhs to Rs.600 lakhs (i.e., 25% of the total power project costs). The costs of generating plant and machinery which were earlier estimated at Rs.1099.59 lakhs have been revised to Rs.1563.10 lakhs (i.e., 65.13% of the total power costs). The year-wise break up of these costs on each item are provided in table 3/Annex VII.

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58. For greater details on these categories, see the "Estimate of cost (Revised) for unit III - Hydro Power Installation, RMP", prepared by the CEE-cum-CEEP, Orissa, Bhubaneswar, Nov. 1976.

But when the costs have been adjusted by us to the base year level, the total power generation costs of the RMP is reduced to Rs.2064.43 lakhs at 1973-74 price level. These adjusted costs for different years, provided in row (8) of table 3/Annex VII, have been used by us for the SBCA of the project.

7.2.4 <u>The O & M Costs of the Project</u>:

With regard to the O & M cost of the RMP no clear guidelines were available to us in the project reports. However, in their attempt to calculate the B-C ratio of the project, the project authorities had computed the annual costs of the dam and appurtnent works portion at the rate of 11% of the initial investment. But this piece of information was not helpful for our purpose because on fundamental economic principles a constant rate of O & M costs over the years appeared to be some what inconsistent to us. Usually with the passage of time the O & M costs of the project would increase. Furthermore, the 11% of annual costs were inclusive of the interest and depreciation charges, that are not relevant for the SBCA. On account of these problems, we have thought it fit to adopt some method in **estimating the** costs under this head for our exercise.

In consultation with the project authorities as well as

the water resource experts we have adopted **an increasing rate** of O & M costs for the various units of the RIP. With respect to the O & M costs of the dam and appurtnent works we have assumed that in the initial years these costs would be 1% of the initial investment excluding B-land. However the same would rise upto 1.5% by the time the project attains its maturity stage (i.e. after 25 years of its operation). Similarly in the case of the O & M costs of the embankments, we have assumed that the above assumptions will hold good. But with regard to the O & M costs of the power project, we have assumed that in the initial years, these costs would be 1.25% of the initial investment and the same would continue to rise upto 2% after 25 years of the life of the project. The O & M costs for the three components of the RIP are provided in table 4/Annex VII.

7.3 THE PROJECT COSTS (Resource based) :

In this section we have worked out the project costs on the basis of the important categories of resources, such as labour, cement, steel and fuel etc., This is done mainly to facilitate the analysis at a later stage when the shadow prices are used. Although we were able to get the gross consumption figures of some important raw materials and inputs, their break-up figures for different years were not available.

Hence, we have adopted a method of approximation for various items of the major resources.[59]

7.3.1 Resource Patterns of Dam & Appurtnent Works:

With regard to one of the important items of dam and appurtnent works, namely, civil works, we have approximated that, at least, 20% of these costs would be labour costs (10% on skilled and 10% on unskilled labour). The other major resources of the civil works like cement, steel and fuel have been approximated at 30%, 25% and 2% of the total costs respectively.

In the case of the costs of land acquisition, while the compensation for land would constitute 66.44% of the total costs earmarked for this purpose, the compensation for property would be 33.56%. On the other hand, in case of rehabilitation and reclamation costs, labour costs would constitute 40% of the costs (30% on unskilled and 10% on skilled labour), and cement and steel each would constitute 5% of the costs under this head.

With respect to the project facilities like roads and buildings we have approximated that nearly 20% of their total

59. These approximations have been adopted by us on the basis of our discussion with the project authorities and some water resource experts.

costs would be labour costs (10% on skilled and 10% unskilled labour), and the costs of cement and steel each would be 12.5% of the total costs under this head.

The figures of there resources for different years, calculated on the basis of the above approximations, are provided in table 5/Annex VII.

7.3.2 Resource Pattern of Embankments:

The important resource that would be required for the construction of embankments and flood gates would consist of labour. We have estimated that nearly 65% of the total costs would be accounted for by labour costs in a backward economy like Orissa, where relatively cheap labour is easily available. Further, roughly 60% of the labour costs would be accounted for by the wages of unskilled labours. The consumption of other materials like cement and steel would not be very significant in these cases.

7.3.3 Resource Patterns of the Power Project:

In case of the power project a bulk of the resources would consist of the generating plant and machinery, and also the tools and plants. While 65.13% of the power project costs would be invested for the generating plant and machinery, 3.50% of the costs would consist of tools and

plants (both special T & P and ordinary T & P). While the prices of machinery and spares would constitute nearly 85% of the costs earmarked for generating plant and machinery, the freight, insurance and handling charges, erection charges would be only 15% of the costs of generating plant & machinery[60]. Usually the employment of unskilled labour for these works would be insignificant.

On the other hand, with regard to the resource requirements for the building and roads and the power house, we have assumed that nearly 20% of these costs would be the labour costs (10% on unskilled and 10% on skilled labour). The costs of cement steel and fuel would be 30%, 25% and 2% respectively of the total costs under this head.

The figures of these costs for different years, calculated on the basis of the above approximations, are given in table 6/Annex VII.

7.4 THE ECONOMIC COSTS OF THE PROJECT:

So far we have calculated the financial costs of the project at the prevailing market prices of resources and

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60. These percentages have been worked out from the Revised cost Estimate for unit III - Hydro-Power Installation, R.P, Orissa.

inputs. But it is a well known fact that these market prices are not the competitive prices which would reflect the true scarcity value of inputs and resources. Often the prices are distorted by the existence of imperfect competition or are regulated by the Government machinery. These prices are unable to transmit the social preferences, as articulated in the national objectives. Thus, the cost calculating valued at current market prices do not reflect the economic costs. Therefore, there is an urgent need to bring about suitable adjustments to the market prices for estimating the economic costs of the project.

In this regard, it has been generally accepted in the literature on project evaluation that when the prices prevailing in the economy do not reflect the true scarcity value of goods and services, one should substitute them by the "shadow prices". In addition to the introduction of shadow prices, there should also be proper adjustments with respect to the "transfer payments" like taxes, subsidies, compensation payments, etc., which represent transfers within the economy rather than payment for the use of resources.

7.4.1 The Concept of Shadow Prices:

The central theme of the literature on SBCA is that the market prices can not be relied upon to measure the

feasibility of a project because the market prices are poor indicators of economic or social benefits and costs due to the presence of: (i) market imperfections (ii) constraints on resource use, (iii) price regulations or support programmes, (iv) built-in biases (in the form of price rigidities), (vi) presence of externalities, (vii) involuntry unemployment of resources, and (viii) undesirable income distribution.

Almost all leading writers on the methods of project evaluation, irrespective of the differences on their approach to the subject, have argued that "shadow or accounting prices" should be used to reflect the true social costs and benefits. These prices are associated with all prices like a ghost. To this extent Mc Kean has rightly observed that, "like deaths and taxes they are always with us".[61]

Further, it is well argued in the literature on SBCA that the perfect competitive long run equilibrium condition provides the general norm for shadow prices. It is also proved that in the long run competitive equilibrium situations the Pareto optimality condition of welfare will be satisfied. Hence, indirectly the Pareto optimality condition provides the norm for shadow prices.[62]

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61. Mc Kean, R.N. "Use of shadow prices" in CBA ed. R.Layard, Penguin Modern Economics Readings, 1976.

62. The counter arguments to this effect are outside the realm of this study; hence neglected in our discussion.

However, the shadow prices are purely economic parameters which are to be decided at the national level by the central planners and these values are to be used by the project evaluator. Therefore, apart from the technological possibilities facing an economy, the shadow prices depend also on the objectives of the Government and the varieties of instruments of policy that the Government possesses.[63]

7.4.2 Application of Shadow Prices in our Study:

In our calculation of the economic and social costs of the RMP, we have made an attempt to introduce the shadow prices of specific resources, viz., the labour inputs and the basic inputs.

(a) Shadow prices of Labour:

With respect to the valuation of the labour inputs of the project we have applied the shadow prices to the unskilled labour only. In the case of skilled labour, it is noted that normally such labour is drawn from similar occupations in which, more or less, the same remuneration is paid as is provided by the project. This category of labour is also in short supply in a backward economy like Orissa. Thus, it

63. See, Guidelines, op. cit.

is reasonable to assume that the skilled labourers are being paid a competitive wage which reflects fairly well their marginal productivity (i.e., the opportunity costs) and as such, their economic value. So there is no need to introduce any adjustment for the wages and salaries of the skilled labourers. However, the same is not true of the unskilled labourers, who are usually drawn from the agricultural sector and generally get a wage in the project which is higher than their marginal productivity. Therefore, the market wage does not represent the economic value of unskilled labour. This implies that in calculating the social costs of the project, there is a need to bring adjustments to the market wage rates of these labourers on the basis of the shadow wage-rate.

ESTIMATION OF SWR FOR UNSKILLED LABOUR:

The shadow price of unskilled labour (alternatively SWR) usually depends on the conditions prevailing in the region from which labour comes and on the region where it seeks or finds employment. The determination of SWR is also constrained by labour mobility, regional variations in labour productivity, and the differing employment/unemployment patterns from one area to another. Therefore, the shadow price of unskilled labour is likely to vary from one project

to another. At least, this is one of the parameters of the SBCA for which a national all-India value is not sufficient.

In determining the SWR, the project evaluator or analyst has to consider the impact of project's employment on the rest of the economy. As shown in the Guidelines and other related approaches to SBCA there would be three types of impact of the additional employment opportunities created by the project.

First, with the shift of labour from some other sector of the economy, say agriculture or the peasant economy, the foregoing sector would loose some productivity equivalent to the contribution of the labour shifted. This is the direct cost component of SWR, which is generally measured in terms of direct opportunity cost of labour or the marginal productivity of labour in the alternative employment opportunities. If the project employs new workers, who were previously unemployed (which is most likely in a labour surplus economy like India), the opportunity cost of labour may be taken as zero. But this argument is not correct because, at least, the labour will be willing to supply his labour for some minimum wage, which would compensate him for his leisure foregone. This supply price being positive suggests that the direct opportunity cost of labour would be positive under general circumstances.

Secondly, there would be some indirect costs consequent on the employment of labour through the effect of the same on the level of saving and consumption in the economy which would in turn bear on the present and future growth of the economy as a whole. In India particularly where the realised saving and investments are not socially optimal, the additional employment of a new project involves the transfer of income from the owners of capital (both the public and private sector institutions) to the labour, with the transfer being equivalent to the wage bill. Since the labour tends to consume practically everything he earns, the extra wage bill will roughly correspond to the extra consumption generated. The additional purchasing power in the hands of the labour may add to the inflationary situations already existing in the economy and thereby create a demand pull in the economy. These impacts on the inflationary pressure would entail some costs to the society. Not only this, the transfer of money from the groups of people with higher MPS to the groups with zero MPS would affect the future investment opportunities (alternatively the consumption of the future generations). Thus, in terms of future growth, the additional employment entails a cost to the society because it adversely affects the inter-temporal distribution of income.

Upto this stage of the analysis, the calculation of shadow price reflects only the economic efficiency of labour and the impact of employment on savings and consumption. The traditional methods of project appraisal have focussed on efficiency or income maximisation as the sole criterion of merit in the selection of projects. More recently, however, the distribution of benefits among different income groups has become a serious issue bearing on the selection of projects. The important consequence of extra employment, viz., better income distribution among various groups of people by way of raising the standard of living of some families as well as providing dignity and security to unemployed persons has been recognised. The increasing concern of the Government for equity in income-distribution has raised the question of the application of extra premium or weight in the measurement of benefits for reflecting social priorities in respect of income-distribution. This is the third type of impact of additional employment opportunities (i.e. the indirect benefits of employment), which should be taken into consideration in the calculation of social costs of labour.

In our estimation of the SWR for the RIP we have attempted to incorporate all the above mentioned three effects of additional employment in the economy. Accordingly, we have devised our formula in the following form:

$$w^* = m + S_c (P_i - 1) w - vw$$

where, w^* = shadow price or SWR of unskilled labour,

m = direct opportunity cost of labour,

S_c = MPS or marginal rate of saving of the capitalist,

P_i = shadow price of investment,

w = wage rate prevailing in the project, and

v = redistributional premium for labour's consumption.

Determination of the Values of the Parameters:

With regard to the values of the national parameters like S_c and P_i, we have borrowed their values from different well-known studies available in this country. Messrs Mishra & Beyer[64] suggested the range of 1.5 to 2.5 for the value of P_i in their calculation of the accounting price of investment (saving). Following their estimates as the best available parameters for India, we have approximated the value of P_i at 2, which is the average of the minimum and maximum range specified by them. In regard to the value of S_c we have approximated it at 0.45 which is the average of the marginal saving rates prevailing in the capitalist sector. Mishra &

64. See, S.N. Mishra & John Beyer; "Cost-Benefit Analysis: A Case Study of the Ratnagiri Fisheries Project, Appendix III-2", Hindustan Publishing Corporation, Delhi, 1976.

Beyer have also suggested a plausible range of values for S_c from 0.3 to 0.5 with values on the upper end more likely to be realistic.

The value of the redistributive premium, v, has been approximated by us as .50. This is based on the subsidies provided by the Government to the landless labourers and the small farmers, who are those who usually seek employment in the public sector projects. Under the MF & AL scheme (Marginal Farmers & Agricultural Labour Scheme) and SFDA Scheme (Small Farmers Development Agency Scheme), which are in operation in Orissa, at least 50% of the subsidies are provided by the Government to these people in order to improve their lot . This clearly indicates that the Government puts a premium of 50% on the consumption of these people.

Next, on the basis of the data collected from the project authorities, the value of w has been taken as Rs.4.00 per day. So the only remaining unknown parameter for the calculation of SWR is "m" which has been estimated by us as follows. Economists have determined the opportunity cost of labour in several ways. One of these is to base it on the average productivity (AP) of labour in the agricultural sector.[65]

65. See, for example the arguments of E.J. Mishan, "Flexibility and Consistency in Project Evaluation", Economica, February, 1974.

The second approach is to use the prevailing market wage rates of agricultural labour in the areas adjacent to the project as a measure of the same. Harberger has demonstrated that in most cases of chronic unemployment (as distinct from cyclical unemployment), labour's social opportunity cost is likely to be fairly close to the observed market wages.[66] But the second approach, as stated above, fails to take into consideration some of the contributions of the labour to social output, which could be in the form of contributions to his own household production at a time when he is not hired by others. For this reason, we have accepted the first approach rather than the second in making our estimates of the opportunity cost of labour. Following this there is a need to measure the average productivity of labour in agriculture.

In order to compute this value with reference to the KIP we made a random survey in the project area. The survey results have shown that most of the labourers of the project, drawn from the agricultural sector, were employed, at least, for 20 days in a month with a wage rate of Rs.3 per day ,

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66. See, A.C. Harberger, "Project Evaluation; Collected Papers, chapter VII", Macmillan, 1972.

i.e. Rs.60 per month.[67] The rest 10 days they were engaged in some sort of domestic works whose value has been approximately computed to be of the order of Rs.15. On the basis of this field data we have estimated that the labour has foregone an earning of Rs.75 per month, i.e. Rs.2.50 per day. The amount of Rs.2.50 per day has thus, been approximated by us as the social opportunity cost of labour.[68]

With these values of the parameters, such as , m =Rs.2.50, S_c = .45, P_i = 2, w = Rs.4 and v = .50, we are now in a position to estimate the shadow price of labour for the RMP. By putting these values in the formula above, we have obtained the value of w^* as Rs.2.30, which is 57.5% of the market wage rate prevailing in the project.[69] This percentage has been used by us for revaluing the unskilled labour costs of the project.

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67. The NSS - 25th Round, "Report on Economic Condition of the Non-cultivating wage-earners in Orissa (Rural)" BS&E, Orissa, Bhubaneswar, 1971 has also supported our results. In this study they have calculated the average rate of earning per manday, which when converted to the 1973 price levels has become Rs.2 per manday.

68. This result corresponds to that of P.G.K. Panikar, "Rural Saving in India", Samaiya Publication Pvt. Ltd. Bombay, 1970. Panikar's result of Rs.500 as the average productivity of labour in the agricultural sector, when converted to 1973 level has become Rs.629 per annum (i.e., Rs.2.50 per manday with the assumption of 250 working days per annum).

69. Our estimate is within the reasonable range of 40% to 60%, that is generally prescribed for the projects in India. For example, see, A.K.Dasgupta "Guidelines for Project. Appraisal" Institute of Economic Growth, (contd...)

(b) Shadow Prices of the Basic Inputs:

With regard to the shadow prices of basic inputs like steel, cement and machinery, it is argued that since these products will be domestically produced, the appropriate basis for determining the shadow prices of these commodities should be the cost of production of these items provided these commodities are produced under competitive conditions. But the paucity of data to this effect has compelled us to use the market prices of these commodities exclusive of taxes and duties as the first approximation of the shadow prices of the same. For fuel, which has an international market and which is mostly imported, the cost of import (cif) should be used as the shadow price. Here also in the absence of adequate data, we have used their market prices exclusive of taxes and duties as the first approximation of shadow prices.

7.4.3 Taxes and Duties of the Basic Inputs:

In our first approximation of shadow prices of the basic inputs, the taxes and duties have been excluded from the prevailing market prices because these do not constitute part of the marginal economic costs of production of the inputs. The taxes and duties are simply the transfer payments between the different departments of the Government (having both the benefit and cost components) and as such, do not

(contd..) Delhi. Mishra & Beyer, op. cit., have also calculated the AWR(accounting wage rate)for unskilled labour as 54% of the market wage rate for Ratnagiri Fisheries Project.

create any real burden for the Government. In Annex VII/ Appendix 1, we have worked out these percentages of taxes and duties in the price of these inputs. And our results have indicated that the taxes and duties of cement, steel and fuel are quite significant; being in the order of 33.73%, 33.26% and 71% of the market prices of these commodities respectively. Whereas, the same is 12% only for the machinery of the power project.

7.4.4 Estimation of Social Costs of Land:

In the financial cost calculations of the project, the compensations payments made to the landowners of the reservoir and work-site areas have been considered as the costs for land. It is well argued in the literature on SBCA that the compensation payments have little economic significance as costs because they are simply the transfer payments, which have both the benefit and cost components. Hence, in the calculation of social costs these transfer payments should be replaced by the "loss of productivity" or the "opportunity costs" of land.

In order to measure the social costs of land in terms of opportunity foregone, first, we have divided the land into various categories such as village sites, low, medium and high cultivable land, orchards, wasteland, forests and others.

Then we have approximated the net productivity per acre for each category of land. The total area under each category of land as well as its net productivity figures are provided in table 7/Annex VII. With the help of these data we have worked out the total losses to society in terms of productivity foregone, which are given in column (6) of the same. Our calculations have shown that while the social costs of land would be Rs.2.18 crores per annum, the financial costs have been estimated to be around Rs.21.60 crores. These social costs of land for different years are provided in table 8/ Annex VII.

7.5 PROJECT COSTS AFTER ADJUSTMENT TO PRICES:

In computing the social costs of the project we have introduced three sets of adjustments, viz., the adjustments with respect to the costs of employing unskilled labour, adjustments of taxes and duties to the prices of capital inputs, and the adjustments relating to the opportunity costs of land. When these corrections have been applied by us to the financial costs of the project, the social costs of various components turn out to be much lower than the financial costs. Accordingly, the social investment costs of the dam and appurtnent works are reduced to Rs.48.99 crores from Rs.60.6 crores of financial costs; for the power project they

reduced to Rs.18.07 crores from Rs.20.64 crores and for the embankments the social costs are reduced significantly to Rs.5.17 crores from Rs.15 crores. These adjusted costs of the dam and appurtnent works, power project and the embankments for different years are provided in tables 5,6 and 4 of Annex VII respectively. However, owing to these corrections, the social costs of the project after its completion (i.e. during the period of its operation) turn out to be higher than the financial costs. This is because of the fact that the costs of land, in terms of productivity foregone, have become a permanent cost for the lifespan of the project.

7.6 PROJECT COSTS IN TERMS OF REGIONAL REDISTRIBUTION:

In a country like India, where the redistribution of benefits and costs of a project between different regions are constrained by the political and social forces and where the objective of redistribution of income could not be accomplished efficiently through macro-economic policy measures such as taxes and subsidies, it becomes necessary to evaluate the impact of this objective on all projects and adjust their benefits and costs with the help of a suitable premium for regional income redistribution. In chapter VI, we have already applied the regional income redistributive premium and accordingly adjusted the project benefits. The value of

the premium for the project area has been approximated at 25%. With the help of the same value of the premium, we have made an attempt to adjust the costs of the RMP in terms of regional redistribution.

However, among all the items of costs of the project the application of this weight is only justifiable in case of the costs of land because these are the costs that will be borne by the people of a backward region. Hence, the regional redistributive premium has been applied to the social values of land. And with due adjustments the land values have increased from Rs.218.23 lakhs to Rs.272.79 lakhs per annum. This is the only adjustment that has been introduced by us to take care of regional redistributive effects of costs.

CHAPTER VIII

SOCIAL BENEFIT - COST ANALYSIS OF THE RMP

8.1 BACKGROUND OF THE SBCA:

In the preceding chapters we have calculated in detail the benefits and costs of the various components of the RMP in financial as well as social economic terms. In computing the benefits and costs we have measured them with reference to the specific overall objectives of the national plan. The aggregate consumption objective has been selected as the basis of our computation of benefits and costs and the other objectives are taken care of by assigning weights to the estimates of benefits and costs. Some of the external effects are also internalized into the pricing system; hence, the indirect benefits have been quantified in monetary terms. The unit of account has been the unit of average consumption in the base year. With these tools in hand, we are now in a position to assess the social economic profitability of the RMP. This exercise is undertaken by altering the estimates of benefits and costs of the project. Further, a necessary precondition for estimating the social economic profitability of a project is knowledge about some matters, which are critical for conducting the SBCA of a project. These matters are: the social rate of discount, and the evaluation criteria

or decision rules for project choice. Thus, one must know the value of social rate of discount and the decision rules. But as our study does not envisage a detailed examination of these matters, we have decided to discuss them briefly.

8.1.1 The Social Rate of Discount (SRD):

The benefits and costs associated with an investment are usually spread over a period of time. Since the life of a project stretches into the future, the costs will be incurred and benefits received at different points of time. It is also well argued by economists that the value of benefits and costs are likely to differ in different time periods owing to inter-temporal time preferences. A unit value of benefit or cost is not identical in different periods due to the inter-temporal effects. This gives rise to the problem of reducing the benefits and costs to a particular base year and to make them commensurate with each other. If one has to add up the benefits and costs, then he must have some rule for assigning weights according to the time of occurence. Under the circumstance, the social rate of discount (SRD) is the appropriate divisor or tool for making the benefits and costs commensurable. Thus, SRD is defined as the rate at which the weight on aggregate consumption declines over time. This represents the collective social time prefere-

-nce about present and future consumption.

(i) Its Application in SBCA:

In the traditional methods of benefit-cost analysis, the procedure adopted was to ignore the time factor and weigh benefits and costs in each period equally;

$$B = \sum_{t=0}^{T} B_t \quad , \text{ and}$$

$$C = \sum_{t=0}^{T} C_t \; ; \quad t = 0, 1, 2, \ldots\ldots, T$$

where, B represents benefits, C the costs and T the life of the project measured in number of years from the date of first investment.

Nevertheless, the above method was unsatisfactory because individuals have time preferences and are not, in general, indifferent to having an additional rupee of income at different points in time. The removal of these drawbacks has given rise to the discounting approach or present value approach. The present value of the stream of benefits and costs spread over a period of time is expressed as:

$$B = \sum_{t=0}^{T} \frac{B_t}{(1+i)^t} \quad , \text{ and}$$

$$C = \sum_{t=0}^{T} \frac{C_t}{(1+i)^t} \quad ; \quad t = 0, 1, 2, \ldots\ldots, T.$$

where, B_t and C_t stand for benefits and costs in the t-th year of the project life and i is the marginal rate of time preference or the social rate of discount.

(ii) Selection of the Value of SRD:

Although the SRD is expected to vary from one period to another and also from one objective to another, in the interest of the manageability of the exercise the SRD is usually assumed to remain constant over the lifespan of a project. The determination of SRD too reflects fundamentally the value judgement of the community. Therefore, it is considered as a national parameter which is supposed to be provided to the project evaluator by the planners.

As regards its value in India, the Planning Commission, GOI was previously using 10% for the evaluation of the projects in the public sector. Only recently the Commission has revised this rate to 12% . While Messers Mishra & Beyer[70] have estimated the range of SRD between 8% to 10% in their study, Dasgupta[71] has recommended a SRD in the range of 8% to 12%.

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70. Mishra & Beyer, op. cit.

71. A.K. Dasgupta, op. cit.

Accepting this range of the value of SRD as most plausible for India, we have decided to use these three rates, i.e. 8, 10 and 12 in estimating the social economic profitability of the RMP.

8.1.2 The Methods of Evaluation:

Many evaluation or decision criteria have been formulated and applied in the past for the selection of projects. The important among the traditional methods of evaluation are:

(a) The pay-back period method, and

(b) The average rate of return method.

But owing to a number of limitations[72] associated with these above methods, of late some other methods are becoming more popular. The commonly used modern techniques of evaluation, known as discount cash flow methods, are:

(i) The NPV method,

(ii) The B-C ratio method, and

(iii) The IRR method.

Each of the above criterion could tell us whether a project is economically viable or not. In recent years these

72. For greater details on the limitation of these methods see, for example; Prest & Turvey "The Main Questions" in CBA, (Ed) Layard and also Smidt and Bierman "The Capital Budgeting Decision".

criteria have been widely applied for the appraisal of projects. In order to judge the worth whileness of the RMP from social viewpoint we have applied these methods. These methods are the standard techniques, widely discussed in the literature on SBCA, and as such need not be elaborated. But notwithstanding their applicability in the study, we feel that it would be better to summarize them here briefly. However, we have restrained ourselves from comparing the relative advantages and disadvantages of each one of them because we have decided to test the feasibility of the RMP with the help of all three criteria.

(i) THE NPV CRITERION:

The net present value (NPV) criterion envisages that the stream of costs and benefits for different time periods of the project should be converted into a common index through the social rate of discount. The decision algorithm of the NPV criterion can be expressed as, "select the projects if the present value of benefits exceeds the present value of costs or if the net present value of benefits is positive". Symbolically, the criterion can be summarized as follows:

$$B > C$$

$$\text{or} \quad B - C = \sum_{t=0}^{T} \frac{B_t - C_t}{(1 + i)^t} > 0$$

where, B and C stand for the present value of the stream of benefits and costs respectively, and B-C for the net present value of benefits.

The NPV criterion gives us an absolute measure of the worthwhileness of a project where the NPV is positive. If B-C $\leqslant 0$, then the project is to be rejected.

(ii) THE B-C RATIO CRITERION:

The B/C provides the benefit-cost ratio for any project. The algorithm of this criterion can be stated as, "select the project if the B/C ratio exceeds unity and in case of a number of projects, rank the projects in descending order of their B/C ratios and select the project from above as per the availability of investment funds".

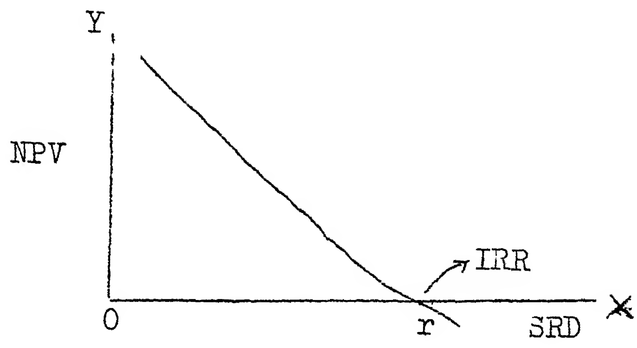
(iii) THE IRR CRITERION:

The internal rate of return (IRR) is defined as that rate of discount at which the net present value of benefit of a project becames equal to zero. If 'r' is the rate of discount at which, B - C = 0

then r is said to the internal rate of return. More explicitly, the formula of IRR can be stated as follows:

$$NPV = \sum_{t=0}^{T} \frac{B_t - C_t}{(1 + r)^t} = 0$$

The IRR can be shown in the graphical form also:



The decision algorithm of the IRR criterion can be stated as, "select the project if the IRR exceeds the chosen rate of discount, i.e., if $r > i$, and if there are many projects, then rank the projects in a descending order of the value of IRR and choose that set of project from the top for which $r \geqslant i$ until the given investment fund is exhausted."

However, the estimation of IRR is a difficult job. Generally, the IRR is determined through the trial and error method. To overcome the hurdles in the estimation of IRR we have devised a computer programme (given in Annex VIII/ Appendix I) and thereby, estimated not only the IRR but also the NPV and the B/C ratio of the RMP.

8.2 ESTIMATION OF B-C RATIO BY THE PROJECT AUTHORITIES:

In their attempt to justify the RMP at the national level, the project authorities had estimated the B/C ratio of

the project; that too, only from the flood control component of the project. On the basis of the allocation of costs by the "Facilities Used Method"[73], they had computed the B/C ratio of the project by a very crude manner. The B/C ratio of flood control was estimated at 2.2. Their calculation of the same is given below for verification and comments.

Table 6: ESTIMATION OF B/C RATIO BY THE PROJECT AUTHORITIES

Benefit-Cost Ratio from Flood Control:

(A) (a) Cost of dam chargeable to flood protection (12.5 + 10.1)	Rs. 22.60 crores
chargeable to irrigation	
(b) Cost of embankment	Rs. 15.00 crores
	Rs. 37.60 crores
Annual costs: at 11% of above	Rs. 4.136 cr.
Annual benefits accrued by flood control	Rs. 6.65 cr.

$$\therefore \text{Benefit-Cost Ratio} = \frac{6.65}{4.136} = 1.37$$

(B) (a) Cost of dam chargeable to flood protection.	Rs. 12.50 cr.
(b) Cost of embankment	Rs. 15.00 cr.
	Rs. 27.50 cr.
Annual costs: at 11% of above	Rs. 3.025 cr.
Annual benefits accrued by flood control	Rs. 6.65 cr.

$$\therefore \text{B - C Ratio} = \frac{6.65}{3.025} = 2.2$$

Source: Annex G, Rengali Dam Project Report (Stage I), 1972.

73. This method & Cost allocation was suggested by the Central Government to the State Governments, vide, Ministry of (contd...)

(i) THE LIMITATIONS:

A critical examination of these calculations of the project authorities would show that the calculations suffer from the following procedural errors.

First, the benefits and costs of the project were not properly estimated. In Annex V/Appendix I we have already pointed out the defects of calculation of flood control benefits of the project. With regard to the cost calculations we have noted that in most cases these were estimated without taking into account the inflationary effects in the economy. Moreover, the benefits and costs were not measured in relation to the broad goals of the national plan.

Secondly, by the method of cost allocations a small proportion of the overhead costs of the project had been allocated to the flood control objective. While the project had been justified on flood control grounds, in case of cost allocations a very small percentage of the dam and appurtnent works (i.e. 30%) had been earmarked for this primary objective of the project. Whereas the power generation, which is a secondary objective of the project, had been allocated 48%

(contd..) Irrigation, Circular dated 17.4.67 addressed to the State Governments. However, at the moment we have refrained ourselves from examining the merits and demerits of the method.

of the overhead costs. This clearly indicates that the costs were unduely underestimated in favour of flood control.

Thirdly, the method of estimation of B/C ratio was defective because in the calculation of benefits and costs no attention was paid to the importance of time stream, i.e., the fact of the benefits and costs spreading over a period of time was not taken into consideration. Further, in the computation of the B/C ratio, instead of taking into account the stream of initial investment costs, they had used the annualized costs which are inclusive of the interest and depreciation charges. But it is well argued in the literature on SBCA that the interest charges and depreciation have no economic significance as social costs because they are only transfer payments in the economy.

Fourthly, no method of discounting was adopted to commensurate both the benefits and costs to a common base year level. Thus, inter-temporal time preference effects were neglected in the analysis.

Fifthly, although there is another important component of the project, namely, power generation in the computation of B/C ratio no attempt was made to introduce the benefits and costs of power generation.

Finally, even though the project had been proposed within the broad framework of the national plan objectives,

it was evaluated, in terms of a typically commercial approach to project appraisal.

8.3 SBCA OF THE RMP:

In order to accomplish the exercise in hand, we have decided to proceed in different stages. Our approach is to carry out the exercise of evaluation with different sets of data, each set generated by a given range of alternative assumptions in the calculation of benefits and costs. With each successive stage, some sophistications have been incorporated into the analysis and then the corresponding economic feasibility of the RMP is examined in the light of the standard evaluation criteria, viz, the NPV, B/C ratio and the IRR.

8.3.1 <u>The Sequence</u>:

The first stage of the sequence of our analysis is by and large with reference to the data provided by the project authorities. Of course, at few places we have introduced our estimates of benefits and costs and other approximations to check the results.

In the second stage, we have carried out the exercise with our estimates of benefits and costs of the project. In this we have incorporated the indirect benefits and costs of the project into the analysis. Both the above exercises, which

are termed as financial analysis, have been undertaken at the market prices of the inputs and outputs. In the third stage, the analysis is modified further by introducing the shadow prices of unskilled labour, by deducting the duties and taxes from the prices of basic inputs and thirdly, by introducing the opportunity cost of land instead of the compensations paid for the same to its owners. This stage is termed as the economic analysis of the project. In the final stage of the sequence, the economic analysis has incorporated the contribution of the project to another broad national objective, viz., the regional income redistributive objective.

8.3.2 SBCA : Stage I

Since we have pointed out many procedural errors with respect to the calculation of the B/C ratio of the project authorities we thought it proper to undertake the SBCA of the project on the basis of the calculations of the project authorities and to check the findings. In this sub-section we propose to test the feasibility of the RMP by applying an improved method of SBCA to the data provided in the project report. However, we have introduced some adjustments at relevant places. The results of these exercises are provided in "Project Summary Matrix, Stage I/table 9.

The analysis has indicated that the RMP could pass all the tests of economic feasibility only if the O & M costs per annum is assumed at 1% rather than 11% of the initial investment. The exercise No.3 of this stage further shows that when one takes the O & M costs at 11% of the initial investment, the project is capable of crossing the test of economic feasibility only at 8% rate of discount, which is the minimum rate prescribed for India. But on the other hand, when we have introduced our estimate of direct flood control benefits, which is more scientific and appropriate, we found that the RMP has miserably failed to pass any one criterion of economic feasibility at 8% rate of discount. The results of exercise No.5 show that at 6% rate of discount the NPV & B-C ratio are Rs.78.30 lakhs and 1.03 respectively. The IRR of the project is worked out at 6.21.

8.3.3 SBCA: Stage II

At this stage of the analysis the direct and indirect benefits as well as costs measured in terms of the aggregate consumption objective are taken into account. In estimating these benefits and costs, the market prices of inputs and outputs at the base year level are used for arriving at the first approximations of the same. These benefits and costs for different time periods are provided in table 7. At this

place, it may be pointed out that although the lifespan of the project has been approximated at 100 years, we have projected the benefits and costs upto 50 years of its life because thereby, the risks and uncertainties in the outcome of the project are reduced to some extent. Moreover, with 8% - 12% discount rate the benefits and costs would hardly be numerically significant after 50 years.

Table 7: STATEMENT OF BENEFITS & COSTS OF THE RMP IN TERMS OF AGGREGATE CONSUMPTION OBJECTIVE

(Figures in lakh Rs.)

Sl No.	Years	BENEFITS: Direct: Flood control	BENEFITS: Direct: Power gen.	BENEFITS: Indirect: Flood control	BENEFITS: Indirect: Others	Total benefits	COSTS: Flood control & embkt.	COSTS: Power gen.	COSTS: Total
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
1.	1973-74	-	-	-	8.56	8.56	260.8	-	260.8
2.	1974-75	-	-	-	22.19	22.19	197.4	92.3	289.7
3.	1975-76	-	-	-	30.61	30.61	330.1	95.9	426.0
4.	1976-77	-	-	-	43.35	43.35	344.2	59.8	404.0
5.	1977-78	-	-	-	56.70	56.70	940.9	145.7	1086.6
6.	1978-79	-	-	-	56.70	56.70	932.7	150.0	1082.7
7.	1979-80	-	-	-	56.70	56.70	1051.5	917.3	1968.8
8.	1980-81	-	-	-	56.70	56.70	1111.4	486.9	1598.3
9.	1981-82	-	-	-	56.70	56.70	714.4	200.7	915.1
10.	1982-83	-	-	-	56.70	56.70	176.6	- 14.4	162.2
11.	1983-85	308.4	700.1	1043.2	52.65	2104.4	339.0	25.8	364.8
12.	1985-88	308.4	708.3	1043.2	52.65	2112.6	339.0	25.8	364.8
13.	1988-98	314.8	859.5	2697.4	52.65	3824.7	57.9	31.0	88.9
14.	1998-2008	316.1	859.5	4180.6	52.65	5409.2	65.2	36.1	101.3
15.	2008-18	316.1	859.5	4180.6	52.65	5409.2	77.2	41.3	118.5
16.	2018-onwards	316.1	859.5	4180.6	52.65	5409.2	81.0	41.3	122.3

Using the above data we have carried out the social benefit cost analysis of the project as follows. The first step in our estimation comprises the measurement of the feasibility of the RMP taking into account its flood control value only. Adhering to the approach of the Government, i.e. by taking into consideration the direct flood control benefits only, our analysis shows that the RMP fails to pass any test of economic feasibility even at 3% rate of discount. But the incorporation of the indirect flood control benefits into the analysis significantly improves the results. The project turns out to become a viable one because even at 12% rate of discount the net present value of benefit works out at Rs.36.56 crores and the B/C ratio at 1.91. The IRR works out to 17.21%.

In the third step we have taken into account the benefits and costs from both the components of the project, viz., the flood control and embankment, and the power generation. Taking into account the direct benefits and costs of the project our exercise shows that while at 8% rate of discount the NPV is Rs.2.36 crores, at 9% the same is Rs.5.81 crores. The corresponding B/C ratios are 1.03 and 0.90 respectively. The IRR with this set of data is calculated at 8.25%. Thus, the RMP has become a worthwhile project only at 8% rate of discount. On the other hand, when the indirect

benefits are introduced into the analysis, the results have changed conspicuously. The outcome of this exercise has proved very satisfactory. Even at 12% rate of discount, the NPV works out to Rs.50.91 crores and B/C ratio 1.97. The IRR works out to 18.07%. Therefore, the project is proved to be socially significant and its contribution to economic development is expected to be of great significance.

8.3.4 SBCA: Stage III

As explained earlier, at this stage, further sophistications are introduced in the analysis by incorporating adjustments to the prevailing market prices of inputs and outputs. While with regard to the benefit stream of the project we have introduced modifications to the power generation benefits only, in the cost side there are three adjustments, such as, adjustments to the value of the unskilled labour component of the project, value of the basic inputs and the value of the land used by the project. The adjusted stream of benefits and costs are provided in the following table:

Table 8: STATEMENT OF ECONOMIC BENEFITS & COSTS OF THE RMP
(in terms of aggregate consumption and regional redistribution objectives)

(Figures in lakh Rs.)

Sl. No.	Years	BENEFITS: Direct: Flood control.	BENEFITS: Direct: Power gen.	BENEFITS: Indirect: Flood control.	BENEFITS: Indirect: Others	Total benefits	COSTS: Flood control.& embkt.	COSTS: Power gen.	COSTS: Total
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
1.	1973-74	-	-	-	8.56	8.56 (10.70)	250.89	-	250.89 (250.89)
2.	1974-75	-	-	-	22.19	22.19 (27.70)	167.37	82.55	249.92 (249.92)
3.	1975-76	-	-	-	30.61	30.61 (38.26)	292.54	21.82	314.36 (314.36)
4.	1976-77	-	-	-	43.35	43.35 (54.19)	300.39	50.13	350.52 (350.66)
5.	1977-78	-	-	-	56.70	56.70 (70.87)	689.28	120.71	809.99 (810.13)
6.	1978-79	-	-	-	56.70	56.70 (70.87)	637.97	126.03	764.00 (769.07)
7.	1979-80	-	-	-	56.70	56.70 (70.87)	729.96	820.97	1550.93 (1561.25)
8.	1980-81	-	-	-	56.70	56.70 (70.87)	864.70	419.68	1284.38 (1313.49)
9.	1981-82	-	-	-	56.70	56.70 (70.87)	667.60	180.47	848.07 (893.86)
10.	1982-83	-	-	-	56.70	56.70 (70.87)	298.65	-14.75	283.90 (338.46)
11.	1983-85	308.4	1166.8	1043.2	52.6	2571.1 (2981.7)	480.72	25.80	506.52 (561.08)
12.	1985-88	308.4	1180.6	1043.2	52.6	2584.9 (2997.5)	480.72	25.80	506.52 (561.08)
13.	1988-98	314.8	1433.1	2697.4	52.6	4497.9 (5213.4)	272.93	30.97	303.90 (358.46)
14.	1998-2008	316.1	1433.1	4180.6	52.6	5982.4 (6938.3)	279.96	36.13	316.09 (370.65)
15.	2008-2018	316.1	1433.1	4180.6	52.6	5982.4 (6938.3)	291.48	41.29	332.77 (387.34)
16.	2018-onwards	316.1	1433.1	4180.6	52.6	5982.4 (6938.3)	294.44	41.29	335.73 (390.29)

Note: The figures in brackets of columns 7 & 10 are the corrected estimates of benefits and costs after applying the premiums for regional redistribution effects.

The effect of these adjustments on the social benefit cost analysis of the project can be observed from the "Project Summary Matrix, Stage III" provided at the end of the chapter. With the incorporation of the adjustments to the prices of benefits only, the results have shown that at 12% rate of discount the NPV and the B/C ratio of the project are Rs.67.89 crores and 2.30 respectively. The IRR turns out to be 19.79%. But with adjustments to the prices of both the benefits and costs streams, the worthwhileness of the RMP has improved further. With 12% rate of discount, the NPV has gone upto Rs.71.07 crores and the B/C ratio to 2.44. Moreover, the IRR has increased to 21.45%.

8.3.5 SBCA: Stage IV

The evaluation of the RMP has proceeded so far by measuring the benefits and costs of the project with respect to the aggregate consumption objective alone. In chapter VI, we have already explained why we have refrained from introducing the other objectives of the national plan, namely, the group income redistribution, employment generation and the self-reliance objective. As such the only adjustment incorporated relates to the regional income redistribution objective. Figures in the brackets of column (7) and (10) of table 8 provide the corrected estimates of benefits and

costs after the application of the regional income redistributive premiums.

The incorporation of this objective into the analysis has enhanced the social economic profitability of the RMP. The social profitability of the project has increased substantially (see, Project Summary Matrix, Stage IV). At this final stage, even at 12% rate of discount the NPV and the B/C ratio of the project are estimated at Rs.88.23 crores and 2.71 respectively. The IRR has moved to 23.08%.

8.4 PROJECT SUMMARY MATRIX:

In order to be guided properly in drawing our concluding remarks and policy implication of the study we have drawn the project summary matrix, which is provided in table 9. The same matrix has pulled together the important findings of our exercises at various analytical stages of the evaluation. Further, we have summarised the key indicators of the project's desirability at each stage of the analysis in the form of a graph, which is provided in Figure I.

A close look at the project summary matrix as well as the graph would show that as we move along the sequence of SBCA, the social economic profitability of the RMP continues to improve. The project has proved to be economically feasible even when the benefits and costs are assessed at

market prices. But the necessary condition for this is that the indirect benefits (more particularly the indirect flood control benefits) should be included in the estimation of benefits. The evaluation of the project in terms of shadow prices of inputs and outputs has enhanced the social profitability of the project to a great extent. With the introduction of the shadow prices, while the B/C ratio has increased by 24%, the net present value of benefits of the project has gone up by 42%. Nonetheless, the introduction of regional income redistributive objective into the analysis has significantly raised the social profitability of the RMP.

Table 9 : PROJECT SUMMARY MATRIX (Quantifiable Aspects)

Stages, Exercises and the nature of estimation of the benefits and costs	Social rate of discount.	NPV (in lakh Rs)	B/C ratio	IRR
(1)	(2)	(3)	(4)	(5)
STAGE I				
Ex.1. Direct flood control benefits & costs as calculated by the project authorities	5	4271.76	2.20	Indeterminate
	8	2221.48	2.20	
	10	1526.36	2.20	
	12	1087.07	2.20	
Ex.2. Direct flood control benefits as per our calculations and the costs calculations with the project authorities	0	Negative	-	

(contd...)

Table 9 (contd.)

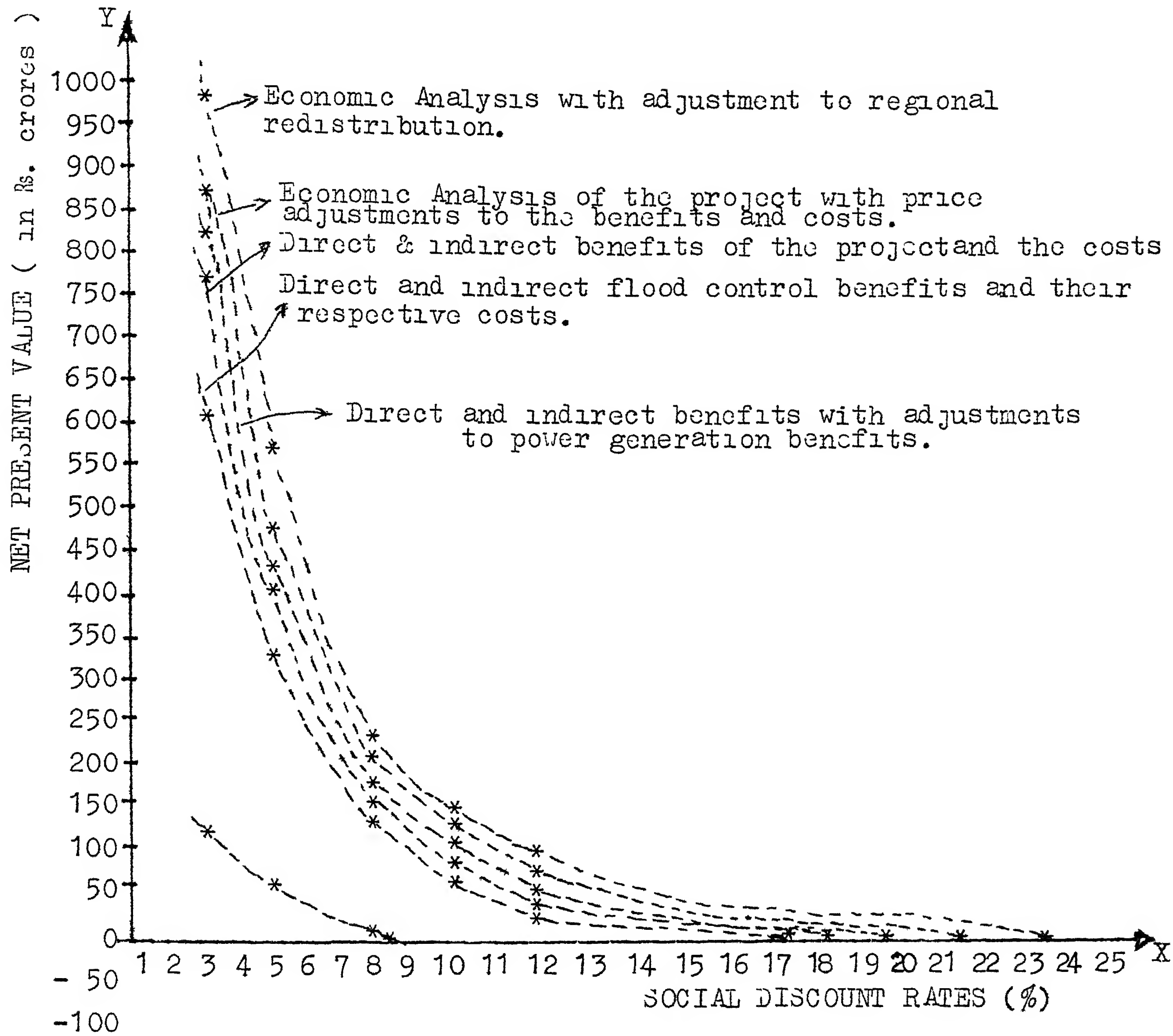
	(1)	(2)	(3)	(4)	(5)
Ex.3	Direct flood control benefits as per the calculation of the project authorities, the initial investment costs for flood control (equally divided between the period of construction) and the O & M costs as calculated by the project authorities	8	228.59	1.06	8.65
		9	- 91.61	0.97	
Ex.4	Estimate of flood control benefits by the project authorities, the initial investment costs for flood control besed on the % of revised cost estimate and the O & M costs at 1% of the initial costs	8	2001.62	1.97	13.50
		10	939.21	1.50	
		12	307.54	1.18	
Ex.5	The cost calculations as per Ex.No.4 and the flood control benefits as per our calculation	3	2125.45	1.73	6.21
		5	534.52	1.21	
		6	78.30	1.03	
		7	-244.11	0.88	
<u>STAGE II</u>					
Ex.6	Direct flood control benefits as per our calculation and the costs of the project.	3	-1298.00	0.83	
Ex.7	Direct & indirect flood control benefits and the costs	3	61765.57	9.23	17.21
		5	32087.92	6.12	
		8	12794.39	3.53	
		10	6977.03	2.56	
		12	3656.59	1.91	
Ex.8	Direct benefits of flood control and power generation and the project costs.	3	12627.00	2.26	8.25
		5	5105.00	1.62	
		8	236.00	1.03	
		9	-581.26	0.90	

(contd...)

(Table 9 (contd.)

(1)		(2)	(3)	(4)	(5)
Ex.9	Direct and indirect benefits of the project as well as the project costs.	3 5 8 10 12	76553.37 40339.16 16558.78 9290.42 5091.77	8.67 5.87 3.50 2.58 1.97	18.07
STAGE III (Economic Analysis)					
Ex.10	Direct & indirect benefits, with adjustments to benefits of power generation and unadjusted costs.	8 10 12	20087.37 11695.49 6789.04	4.03 2.99 2.30	19.79
Ex.11	Direct and indirect benefits, with adjustments to benefits of flood control and power generation and the adjusted costs.	3 5 8 10 12	85365.79 46035.37 19946.16 11851.87 7106.84	7.74 5.88 3.94 3.08 2.44	21.45
STAGE IV (Regional Income Redistribution Analysis)					
Ex.12	Direct and indirect benefits with adjustments to regional redistribution of income.	3 5 8 10 12	99853.43 54172.59 23820.97 14377.15 8823.25	8.20 5.33 4.31 3.39 2.71	23.08

FIGURE I: GRAPH SHOWING THE NPV & IRR OF THE RMP



CHAPTER IX

CONCLUSIONS & POLICY IMPLICATIONS OF THE STUDY

In this final chapter we have brought together the conclusions and policy implications derived from the study.

9.1 THE CONCLUSIONS:

The broad conclusions emerging from our study are summarised as follows: first, our results of the SBCA have shown the worthwhileness of the RMP in the context of the economic development of the country in general and Orissa in particular because of its high social profitability. Apart from its economic contribution, the project is strongly recommended and justified owing to many additional social benefits, which are not reflected in our evaluation of the project. For all these reasons it is believed that the RMP would make an important contribution both to the development of the national economy and to the welfare of the people of Orissa. Hence, its inclusion in the Fourth Five-Year Plan's allocation of funds has been justified.

Secondly, it is affirmed that, by and large, the net present value of benefits, B-C ratio and the IRR are highly sensitive to the introduction of shadow prices of inputs and outputs of the project. A scrutiny of the "Project Summary

Matrix" indicates that with the adjustment of shadow prices in the analysis, the values of NPV, B/C ratio and IRR have improved significantly.

Thirdly, our exercises of evaluation have demonstrated that the RMP is also highly sensitive to the estimation of indirect flood control benefits. The indirect flood control benefits are worked out to be quite significant and prominent. Our estimates of benefits have clearly showed that the indirect flood control benefits are much more pronounced than the direct flood control benefits. Further, the incorporation of the indirect flood control benefits in the analysis have improved the economic feasibility of the RMP significantly.

Fourthly, our primary survey results have ensured the importance of a flood control project for the creation of additional employment opportunities in the flood-plain. Because of the extensive and intensive methods of cultivation in the flood-plain there has been a significant growth of employment facilities for the unskilled labourers. Thus, it is expected that the RMP would generate significant employment opportunities in the Brahmani flood-plain.

Fifthly, although it has been shown in several studies that water from irrigation is an important pre-condition for the spread and success of the green revolution, we may add

further that without the development of a flood control project in the various flood-plains of the country, no green revolution would be successful.

Lastly we maintain that the RMP would not only contribute to the efficiency of the economic system but also to the objective of promoting an equitable distribution of wealth and income in the economy by way of helping the rural farmers and labourers.

9.2 THE POLICY IMPLICATIONS:

On the basis of (i) the results of the social benefit-cost analysis of the RMP, and (ii) some other data collected by us during our extensive field works in connection with the study, we have decided to draw some policy implications, which would be highly relevant for the Government. The general policy implications emerging from the study are summarised as follows:

(1) The most important policy implication of the study is derived from the identification and quantification of indirect flood control benefits of the RMP. The study has shown that the indirect flood control benefits of a multipurpose river valley project like the Rengali Multi-purpose Project are much more prominent and significant than the

direct flood control benefits. Therefore, the project evaluator and policy maker should not neglect these benefits in determining the social economic feasibility of such projects.

(2) We know that devising solutions to the problems of a multi-purpose river valley development scheme needs the participation of many disciplines such as, economics, engineering, agriculture, geography, forestry, and public administration. At the stage of investigation of these projects there should be a co-ordinated effort by experts from different related disciplines, i.e., there should be a comprehensive and integrated approach to the problems. Thus, we advocate that the prevailing practice in India, whereby the projects are being investigated and formulated by technical personnel only, should be changed. Instead the Government ought to initiate the practice of associating geographers, agricultural scientists, revenue authorities and economists in the task of evaluation of such projects. Thereby, the difficulties and delays in the construction of the project could be reduced to a great extent.

(3) Further, in the stage of investigation of such projects, the various alternative locations and components of the project should be properly worked out and their

corresponding economic benefits and costs should be estimated in relation to the specific objectives of national planning. The decision for the execution of the project should be taken after evaluating the social and economic benefits and costs of each one of the components of the project as well as examining the bearing of the location of the project on the costs and benefits. Sometimes the pursuance of one objective of the project may conflict with another objective; under such situations the decision maker should examine the various "trade offs" and then take a decision.

(4) Generally, at the project level the preliminary as well as final reports prepared by the Governments are based on a very weak data base. Further, there is no follow-up attempt to improve the data, which could provide a good base for future policy decisions. In this regard, we have come across many serious overestimated or underestimated data used by the Rengali Project Authorities. The assumptions and approximations used by them are not based on any scientific study. These are not properly justified before being used in the project report. Therefore, we feel that there should be a scientific approach to data collection and their interpretations. More particularly, at the stage of project design the authorities concerned should try all possible sources for expanding the data-base.

(5) Furthermore, the justification provided by the authorities of the Central Water Commission, GOI, that usually they thoroughly scrutinize the structural designs of such a project rather than the economic and social implications of it, is having its wider implications. The justification was not convincing to us because, after all, the technical personnel design the project as a result of which the impact of the project on the social and economic spheres tends to get neglected at the stage of scrutiny of the project. The same exercise should be conducted either by the Central Water Commission or the Planning Commission, GOI.

(6) This implication relates to the scope of project evaluation at the stage of the construction of the project. In this context, we maintain that instead of the general belief of ex-ante or ex-post evaluation, it is much more important to evaluate the project in one way or another during the whole period of construction and execution of the project. Bergmann has rightly observed that, "A posterior calculation during the construction period and throughout the operation of the project has so far been neglected by all Governments and institutions, but it is precisely this which could give valuable indications for improving the bases of a-priori calculation and to provide the elements

needed to improve the management of the project."[74] Moreover, the evaluation of a project at the stage of construction would help the policy decisions required during the operation of the project. It may also help adopting some follow-up measures by which the potential benefits would be enhanced and the costs reduced.

9.3 THE IMMEDIATE POLICY IMPLICATIONS:

Apart from the above general policy implications we have also identified some immediate policy implications, which would be very much helpful to the Government of Orissa as well as the project authorities. Our findings of the SBCA and the field observations have induced us to draw these implications. The first important implication relates to the need of a comprehensive development plan of the Brahmani flood-plain. In our estimation of benefits we have already made a forecast that there would be significant agricultural development in the Brahmani flood-plain after the completion of the RMP. But the general trend that has emerged in India (and more particularly in Orissa) is not encouraging. The reclamation of the submarginal lands and the adoption of

74. See, Hellmuth Bergmann, "Guide to Economic Evaluation of Irrigation Projects", OECD, Paris, 1973.

intensive methods of cultivation involve a considerable time-lag because the people may not undertake the follow-up actions immediately after the completion of the project. Thereby, the potentials generated by the RMP would remain unexploited. Under this circumstance, we feel that to overcome these difficulties the Government of Orissa should step in with a comprehensive plan for the reclamation of sand-casted and water-logged lands in the Brahmani flood-plain. Further, the farmers should be educated to adopt the intensive methods of cultivation after the control of floods. The Command Area Development Programme should be extended to these areas. Unless the Govt. of Orissa is prepared to provide these incentives to the farmers of this flood-plain, there would be a considerable discrepancy between the potential created and its utilization and thereby, a social loss would occur.

Secondly, we have identified that the big reservoir created for flood control would provide very good opportunities for the development of fisheries. The Govt. should direct its Fisheries Department to make adequate arrangements for the maximum exploitation of these potentials. Unlike the Hirakud reservoir, the Govt. should plan for sufficient investment in this direction so that there would be no scope for wild fish development in the Rengali reservoir area in

future. Accordingly the project authorities should clear up the stumps from the reservoir in such a way that there would be no difficulty in catching fish. In accordance with the phased programme of submergence, the forests should be cleared so that there would be no chance of any vegetation to remain under water.

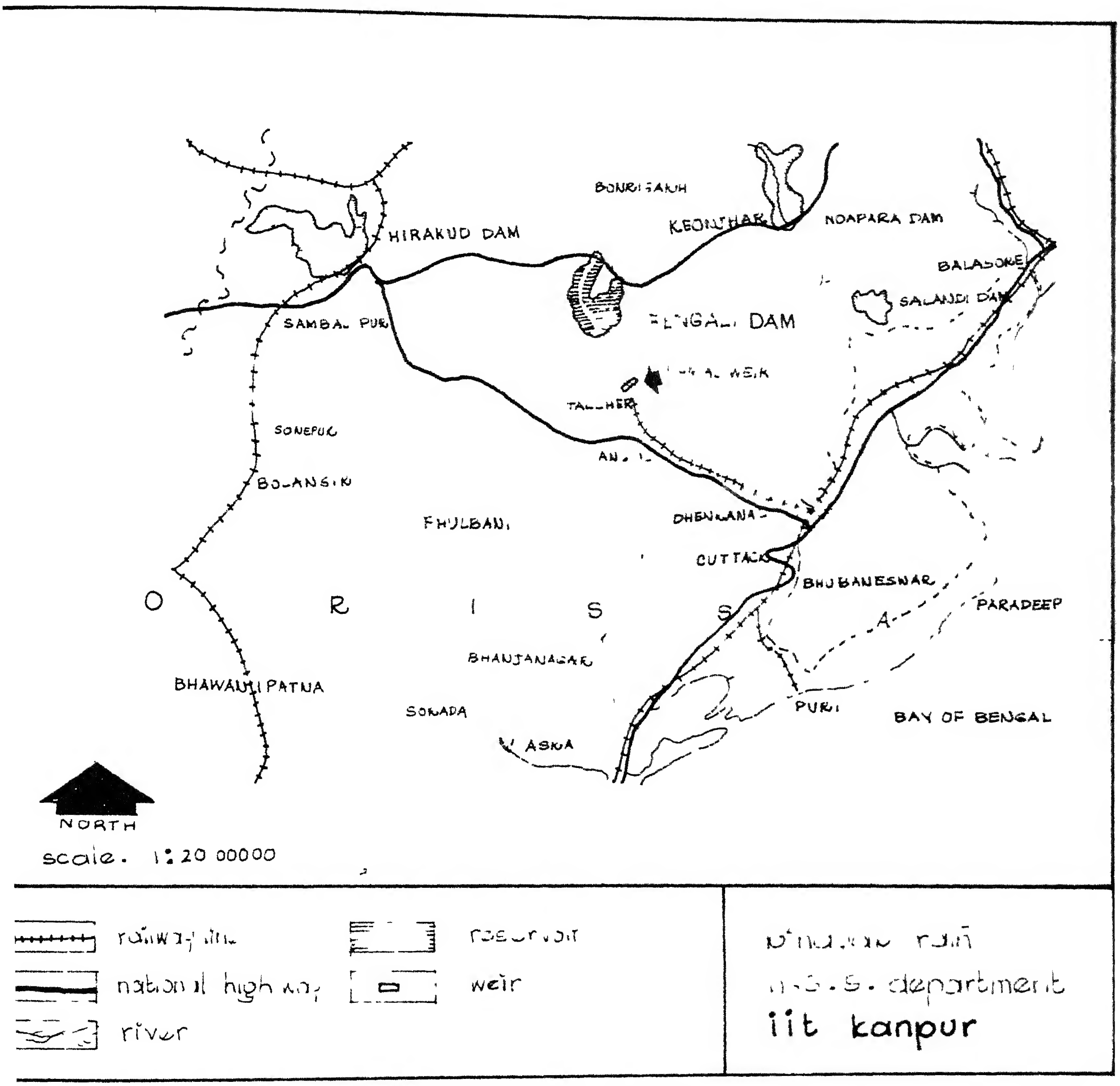
The third implication is developed with reference to the utilization of the firm energy to be generated by the RMP. In Annex II/Appendix II we have provided the past and projected consumption pattern of electricity in Orissa. Our critical evaluation of the consumption pattern of electricity in Orissa has highlighted that the agricultural sector, which contributes more than 65% of the state's GNP and which provides employment to 70% of population, is totally neglected. The use of electricity for agricultural development has yet to reach 1% of total consumption in Orissa. On the other hand, the industrial sector, which consumes more than 88% of the electricity supply in the State, has not contributed significantly in the direction of removal of the backwardness of the state. In view of the discrepancies in the consumption patterns of electricity in the State, we feel that there should be a radical change in the pattern of consumption of electricity. Priority should be given to the exploitation of the ground water and surface water potentials. Hence,

we insist that the electricity to be generated by the RMP need not be supplied to the OSEB directly. On an experiment basis perhaps, the electricity generated by the RMP should be managed by the Department of Irrigation & Power directly and should be supplied to the different sectors of the economy on the basis of its contribution to the social and economic development of the region. The power should not be supplied on a commercial calculation as is done by the OSEB. Keeping in view the objectives of socio-economic development, we may suggest a pattern of distribution of electricity generated by the RMP as follows. In the first place, the electricity should be supplied to those people who would be affected by the submergence of land under the reservoir. They should be provided with electricity at a preferential rate for their domestic use as well as for agricultural use. Further, with the help of the electricity the ground water potentials, which are likely to be generated in the vicinity of the reservoir, should be exploited. Next, there should be the development of small scale industries in the project site after the completion of the project. These small scale industries could avail the facility of infrastructures developed by the project and also the cheap power from the project. After these demands are met, the remaining part of the electricity generated by the project should be sold to

the OSEB. The above use of the electricity of the project as envisaged by us could reduce the cost of transmission on the one hand and raise the social benefits on the other.

Our last immediate policy implication is that the RMP would increase the potential for revenue collection in the Brahmani flood-plain, which should be exploited in due course to raise the meagre revenue of the State. The residents of this flood-plain are expected to be benefited in two ways, viz., from the aversion of flood damages and further from the potential agricultural development in the flood-plain. Therefore, the Government should either impose a betterment levy or a tax on the agricultural income of these beneficiaries. Of course, these measures should be undertaken a few years after the completion of the project. The Government of Orissa should carefully consider the feasibility of this measure keeping in mind the fact that the resources are to be raised in the future to accelerate the development of the State.

THE RENGALI PROJECT SITE ALONGWITH EXISTING AND PROPOSED MAJOR PROJECTS, ORISSA



ource: irrigation & power department

THE WATERSHED AREA OF THE BRAHMANI, MAHANADI AND THE BAITARANI, ORISSA

state boundary

river

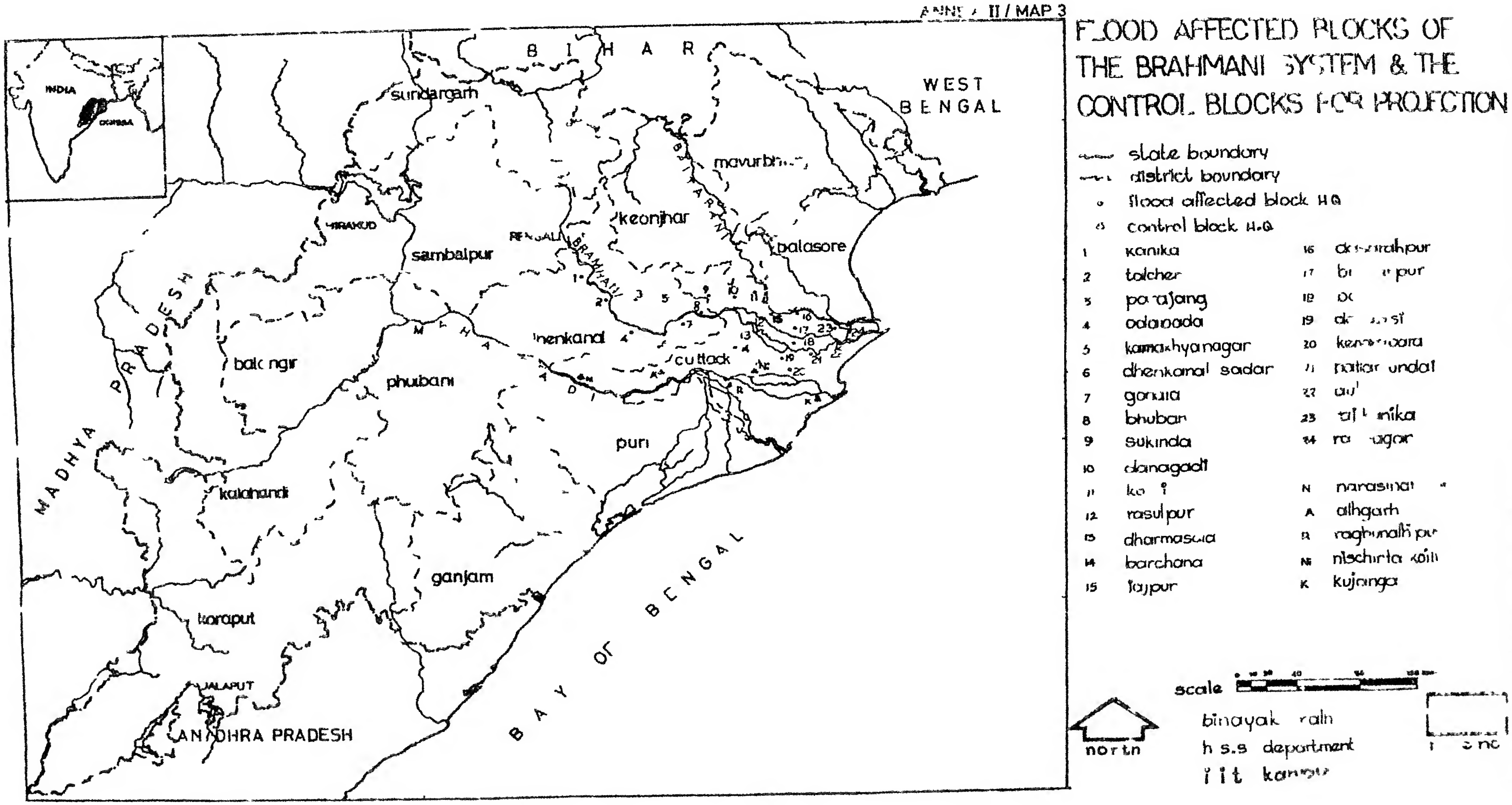
water shed boundary

50 25 0 50 mil

Scale

iit kanpur

Source: Floods in Orissa rivers 1955-56 Final reports Revenue department (special relief) Govt of Orissa Bhubaneswar


ANNEX II / MAP 3
FLOOD AFFECTED BLOCKS OF THE BRAHMANI SYSTEM & THE CONTROL BLOCKS FOR PROJECTION
state boundary
district boundary
flood affected block H.Q
control block H.Q
1 kanika
2 talcher
3 parajang
4 odapada
5 kamakhyanagar
6 dhenkanal sadar
7 gondia
8 bhuban
9 sukinda
10 danagadi
12 rasulpur
13 dharmasala
14 barchana
15 jajpur
N narasinghpur
A athgarh
R raghunathpur
Ni nischintakoili
K kujanga
scale
north
binayak rath
h.s.s department
iit kanpur
INDIA
ORISSA
BIHAR
WEST BENGAL
MADHYA PRADESH
ANDHRA PRADESH
BAY OF BENGAL
sundargarh
sambalpur
keonjhar
mayurbhanj
balasore
dhenkanal
cuttack
puri
phulbani
balangir
kalahandi
ganjam
koraput
HIRAKUD
JALAPUT
BRAHMANI
BAITARANI
MAHANADI

ANNEX II

Table 1

STATISTICAL DETAILS OF THE THREE MAJOR RIVER SYSTEMS OF ORISSA

Sl. No.	Statistical details	Units	Mahanadi	Brahmani	Baitarani
(1)	(2)	(3)	(4)	(5)	(6)
1.	Length of the river	Miles	533	438	216
2.	Length of the river from the source to the commencement of the deltaic region.	Miles	466	345	153
3.	Watershed area	Sq.miles	51,000	14,000	4,000
4.	Volume of water-flow in the river at the head of the delta:				
	i) Maximum flow	Cusecs	15,71,000	6,43,290	5,00,000
	ii) Minimum flow	Cusecs	200	130	74
5.	Area of the deltaic region.	Sq.miles	2,940	854	659
6.	Protected area irrigated by canals.	"	641	62	190
7.	Area protected by embankments but not irrigated.	"	456	166	103
8.	Semi-protected area inundated only in high floods.	"	725	192	177
9.	Normally inundated by floods.	"	475	230	140
10.	High lands and jungles not affected by floods.	"	278	124	30

Source: "Floods in Orissa Rivers, 1955-56 Final Report", Revenue Dept. (Special Relief), Government of Orissa, Bhubaneswar, 1957.

ANNEX II
Table 2

STATISTICAL DETAILS OF THE BRAHMANI FLOOD-PLAIN

Sl. No.	Name of the Block/NAC/ Municipality	Sub-division	No.of villages suscepti-ble to floods	Population liable to be affected by floods	Cultivated area subjected to floods by Brahmani system(in Acr.)
(1)	(2)	(3)	(4)	(5)	(6)
1.	Kaniha	Talcher	34	21,782	2,289
2.	Talcher	"	15	5,186	1,231
3.	Talcher Muni-cipality	"	3	840	260
4.	Parajang	K.Nagar	28	11,102	2,825
5.	Odapada	Dhenkanal	39	31,750	7,491
6.	Dhenkanal Sadar	"	27	13,661	2,727
7.	Kamakhyanagar	K.Nagar	34	9,580	3,382
8.	Bhuban	"	29	11,172	5,130
9.	Bhuban NAC	"	16	1,686	2,065
10.	Gondia	Dhenkanal	40	15,500	8,675
11.	Sukinda	Jajpur	31	12,425	6,034
12.	Danagadi	"	59	23,256	5,700
13.	Jajpur Road NAC	"	4	805	428
14.	Korei	"	30	16,594	7,384
15.	Rasulpur	"	151	90,000	26,145
16.	Dharmasala	"	146	72,000	26,588
17.	Badachana	"	78	59,291	16,189
18.	Jajpur	"	97	47,544	26,062
19.	Bari	"	105	92,000	34,938
20.	Binjharpur	"	43	45,686	25,000
21.	Dasarathpur	"	14	14,282	15,408
22.	Kendrapara	Kendrapara	18	16,310	916
23.	Derabisi	"	24	18,265	1,188
24.	Pattamundai	"	122	91,875	40,134
25.	Aul	"	124	90,702	41,407
26.	Rajkanika	"	122	78,334	8,899
27.	Rajnagar	"	91	30,602	27,042
	Total		1,524	9,22,259	3,35,109

Source: (1) The data of Sl.No.1 to 10 are collected from the offices of the SDOs of the Dhenkanal district. The data relates to the highest flood year i.e. 1975.

(2) The rest of the data are computed from the FDRs of Cuttack district on the basis of apportionment of damages for each block by the Brahmani system only.

ANNEXURE II
APPENDIX I

RENGALI DAM PROJECT: SALIENT FEATURES

Location:

Rengali	Dist.	Dhenkanal, Orissa
Latitude	$20^{\circ}\ 17'\ 0''$ N	
Longitude	$85^{\circ}\ 02'\ 0''$ E	

Hydrology:

1)	Drainage area at the dam site	25,250 sq.km.
2)	Mean Annual rainfall in watershed	157 cms.
3)	Mean Annual Run-off at the dam site	1.49 Million Ha.M.
4)	Design Flood at dam site:	
	a) 1000 Yr. return period	27,800 Cumecs
	b) Maximum probable flood	55,540 Cumecs

Reservoir:

1)	Storage capacity at M.W.L.	5.15 Lakh Ham.
2)	Storage capacity at F.R.L.	4.40 Lakh Ham.
3)	Maximum water level (M.W.L.)	125.40 M.
4)	Maximum Reservoir level (M.R.L.)	123.75 M.
5)	Dead Storage Level (D.S.L.)	109.75 M.
6)	Dead storage capacity	0.988 Lakh Ham.
7)	Water spread Area	406 sq. Km.

Dam:

1)	Type	Gravity massonary type
2)	Length of the Dam (overall)	1040 M.
3)	Length of Spillway	464 M.
4)	Length of power Dam	84 M.
5)	T.B.L.	128.50 M.
6)	Average Height	45 M.
7)	Spillway Gates	24 Nos. Steel gates
8)	Maximum Height of the Dam above foundation	65.5 M.
9)	Deepest foundation level	60.00 M.

ANNEX II
APPENDIX 2

THE STATE OF ORISSA

GENERAL:

The state of Orissa, covering a total geographical area of 1,55,845 sq. kms. (4.7% of the total geographical area of the country), is located in the eastern region of Indian peninsula with an extensive hinterland for towards the west. Having a population of 254 lakhs by mid- 1978 (4% of the population of India), Orissa is predominantly a rural state, with almost 92% of the population living in rural areas and dependant almost exclusively on agriculture for its living. While the state is gifted with nature's bounty in the form of vast forest resources (42.8% of land is covered with forest), plentiful of monsoon rains, abundant water resources, plenty of mineral deposits and long stretches of fertile tracts alongside the 402 kms. of sea coast, the underutilization as well as wasteful use of these resources have indeed resulted in object poverty of the people in the midst of plenty. The rural institutions are generally weak and most of the economic indicators of growth for the state, given in Annex II/Appendix 2/Table 1, are lagging behind the all-India average.

CLIMATE:

The state is situated within the tropical belt and as such has a tropical monsoon climate. The average annual rainfull of Orissa is approximately 60 inches, with maximum precipitation during the Kharif season from June to October (nearly 85% of the rainfull occur during this period). However, it varies between 50 inches and above in the parts of Koraput, Kalahandi, Sambalpur, Sundergarh and Mayurbhanja districts to below 30 inches in Ganjam and parts of Koraput, Cuttack and Puri districts. There is also considerable variation in amount of rainfall (as high as 50% from one year to the next) as well as an erratic trend in the pattern of rainfall with respect to the timings. Owing to these variations and uncertainities in rainfall, supplementary irrigation during Kharif season becomes necessary for high and stable yields. Further, consequent upon the low rainfall in the Rabi season, intensive cropping is only feasible with the development of irrigation potentials both in the form of flow and groundwater.

TOPOGRAPHY & SOIL:

Orissa's landscape extends from the northern fringe of the Eastern Ghats to the tidal and marshy coast of the Bay of Bengal. On the basis of its physical feature and agro-climatic conditions, Orissa may be roughly divided into four zones:

(i) the Northern Platean (23% of the State's area) characterized by hill ranges rising to elevations of 2,000 ft. to 3,000 ft. above sea level;

(ii) the Central Table Land (23%) generally flat with slightly undulating and folded topography rising to elevation of 1,000 ft.;

(iii) The Eastern Ghat Region (36%) with hill ranges along with some plains and valleys lying between them, with elevations of the plateaus ranging from 900 ft. to 2,000 ft.; and

(iv) the Coastal Plains (18%) consisting of the littoral tracts alongside the Bay of Bengal and the alluvial plains.

Further, the landscape comprises of different types of soils, namely, the red soil (covering a major portion of the land), the laterite soil, the black soil, the mixed red and black soil, the red and yellow soil, the brown forest soil, the alluvial soil and the saline soil.

LAND UTILIZATION & FARM SIZE:

It is estimated that out of the total geographical area of 15.5 million ha. 8.03 M. ha. would be ultimately cultivable. The land utilization pattern for the year 1976-77 has revealed that 42.8% of the land was under forest (being the highest percentage in India), 3.5% was not available for cultivation, another 3.5% was under permanant pastures and grazing land, 3.2% was under miscellaneous trees, crops and groves, 1.8% was cultivable waste, and 5.6% was under current fallow. The net area sown was only 37.8% of the total geographical area of the state.

With respect to size of farms, the 'small' and 'marginal' farmers, with holding of less than 2 ha. represent

roughly 26 lakhs out of 34 lakh cultivators' households. Although these farmers operate over 75% of all operational holdings, they control less than 40% of the total cultivable land, while farms of 5 ha. or more (representing less than 7% of holdings) account for about 35% of the land. Adding to the skewed distribution of income in the rural areas are the landless and agricultural labours, who constitute an additional 18 lakh households.

SOCIO-ECONOMIC CONDITIONS:

The socio-economic conditions of the people of Orissa are very poor. Most socio-economic indicators are inferior to the rest of India. About more than 60% of the population have income below the poverty line (i.e. Rs.540 per capita per annum as per the World Bank specifications). While Dandekar and Rath estimated that in 1961-62 about 44% of the rural population did not get food supplying the minimum required calories, the NSS in a similar exercise for the year 1971-72 had indicated that this had increased to about 65% of the rural population.[1] In 1978-79 it was pointed out that this figure had further gone upto about 80%.[2] At current prices the per capita income of the state (in 1975-76) was Rs.731 (the last but one among the major states of India) while the comparative all-India average was Rs.936. Over the years the gap between the national per capita income and the state per capita income has not decreased.

With regard to the composition of population of the state, it is stratified along caste, class and tribal lines, with SC & ST making up about 38% of the total population. Nearly 80% of the population depend on agriculture and its allied activities for their livelihood. While the labour force constitute 31% of the total population, cultivators and agricultural labours account for 49% and 28% of the labour force respectively.

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1. Source: Prof. N.Rath, "Presidential Adress, Eleventh Annual Congrence of Orissa Economic Association", Berhampur, February 18-19, 1978.

2. Based on the statement of the Revenue Minister of Orissa in the Legislative Assembly during the Budget Session of 1978-79.

AGRICULTURAL DEVELOPMENT:

Agriculture dominates Orissa's economy because it is the main economic activity in the State. Agriculture and its allied activities contribute more than 65% of state's domestic product.[3] Agriculture employs about 80% of the total labour force. The livelihood of about 80% of the population is in someway dependent on agriculture.

Although paddy is the most important crop (70% of the cropped area) in the state, the yields are very low. Normally the foodgrain yields are much lower than the national average. The poverty and traditional outlook of the people (particularly of the farmers), lack of irrigation facilities and other infrastructural facilities, lack of modernisation techniques, lack of entrepreneurial ability, inadequate agricultural supporting services and lastly the fragmentation of land holdings are some of the inhibiting factors those which are responsible for the low yield rate in agriculture. In spite of the best efforts of the Government for agricultural development, the cropping intensity (about 12.5%) in the state remained more or less stagnant during the decade 1964-74 due to the above mentioned constraints. The era of "Green Revolution" is yet to commence in Orissa. But the recent assistance of the World Bank and Govt. of India are commendable and hence, it is expected that the agricultural production in the state would take a remarkable turn in the coming years.

IRRIGATION, FLOOD CONTROL & POWER DEVELOPMENT:

To provide a broader base for our analysis we have included the development of irrigation, flood control and power generation as well as the utilisation of irrigation potentials and the consumption patterns of electricity during the plan periods in Annex II/Appendix 2/Tables 3 to 8 (only in tabular forms). These tables may be looked into by the reader for better understanding of the problem in the coming chapters.

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3. Cf. Annex II/Appendix 2/Table 2.

ANNEXURE II

APPENDIX II

Table 1

SOME SOCIO-ECONOMIC INDICATORS OF ORISSA VIS-A-VIS ALL INDIA

Item		Unit	Reference year	Orissa	All-India	Source of Data*
1		2	3	4	5	6
1) AREA & POPULATION						
i)	Geographical area	thousand sq. Kms.	1978	156 (9)**	3,288	CMIE
ii)	Total population	lakhs	mid-1978	254 (11)	6,307	CMIE
iii)	Density of population	person per sq.Km.	1978	163 (12)	192	CMIE
iv)	SC & ST population	percentage of total population	1971	38.2 (1)	21.5	BSE
v)	Urban population	percentage	1971	8 (15)	20	CMIE
vi)	Literacy	percentage	1971	26.18 (10)	29.45	BSE
2) AGRICULTURE:						
(A) Land Utilization						
i)	Area under forest	percentage to total area	1976-77	42.8 (1)	21.6	BSE
ii)	Area not available for cultivation	"	"	3.5	14.00	BSE
iii)	Net area sown	"	"	37.8 (14)	46.9	BSE

(continued)

(contd.)

1	2	3	4	5	6
(B) General:					
i) Average rain-fall	cms	-	153 (5)	121	CMIE
ii) Gross irriga-ted area.	percentage of gross cropped area	1976-77	21.00 (9)	28.00	CMIE
iii) Consumption of fertilizer	In Kg. per hectare of cropped area	1976-77	7.4 (13)	17.1	BSE
iv) Yield rate of rice	In Kg. per hectare	1978	7.3 (15)	10.6	CMIE
v) Annual rate of increase in foodgrains output	percentage	1961-62 to 1977-78	1.4 (13)	2.5	CMIE
3) INDUSTRY					
i) Registered factories	Number	1975-76	1,005	72,000	BSE
ii) Large scale industries	Number	1975-76	38	-	DOI
iii) Percapita gross output in industry	Rupees	1969	99 (13)	220	BSE
iv) Per capital value added in industry	Rupees	1969	22 (12)	51	BSE
v) Per capita value added by factory sector	Rupees	1975-76	42	107	CMIE

(continued)

(contd.)

1	2	3	4	5	6
4) POWER ENERGY					
i) Percapita consumption of electricity	KWH	1975-76	109.39	109.95	BSE
ii) Percapita domestic consumption of electricity.	KWH	1976-77	3 (13)	10	CMIE
iii) Villages electrified	percentage	March 1978	28 (12)	38.00	CMIE
iv) LT paints energiged	thousand Number	1976-77	5	3,041	BSE
5) WORK FORCE					
i) Workers to total population	Percentage	1971	31.2 (7)	32.9	BSE
ii) Workers engaged in Agrl.sector	"	1971	79.6 (3)	72.1	BSE
iii) Share of Agrl. labourers	"	1971	28.3 (6)	26.3	BSE
iv) Workers engaged in the manufacturing sector	"	1971	5.9 (13)	9.4	CMIE
a) Factory	"	1971	1.00 (15)	2.8	CMIE
b) House hold	"	1971	3.6 (7)	3.5	CMIE
c) Non-factory and non-household	"	1971	1.3 (13)	3.1	CMIE

(contd.)

(contd.)

1	2	3	4	5	6
6) INFRASTUCTURE & BANKING					
i) Index of infra-structure development	-	1976-77	79 (14)	100	CMIE
ii) Bank offices per lakh of population	Number	June, 1978	3 (13)	5	CMIE
iii) Per capita deposits	Rupees	Dec,1977	81 (15)	342	CMIE
iv) Per capita advances	Rupees	Dec, 1977	47 (15)	247	CMIE
7) INCOME, EXPENDITURE AND PLAN OUTLAY					
i) Per capita income	in rupees	1960-61	216.5	305.6	BSE
ii) Per capita income at current prices	In rupees	1975-76	731 (14)	936.00	CMIE
iii) Per capita revenue receipt	In rupees	1977-78	150	217	BSE
iv) Per capita revenue expdr.	In rupees	1977-78	139	216	BSE
v) Per capita plan outlay	In rupees	1976-77	51	127	BSE

* Source of data: The abbreviations are:

1) CMIE: Centre for Monetoring Indian Economy, Bombay, Dec. 1978

2) BSE : Bureau of Statistics and Economics, Government of Orissa, Bhubneswar, 1977 [illegible]

3) DOI : Directorate of Industry, Govt. of Orissa, Cuttack.

** Figures in the brackets indicate the rank of the State among the major states under the respective row. The major states are defined as the states with a population of one crore and above; namely, U.P., Bihar, Maharashtra, West Bengal, Andhra Pradesh, Madhya Pradesh, Tamil Nadu, Karnataka, Gujarat, Rajasthan, Orissa, Kerala, Assam, Punjab and Haryana.

ANNEXURE II

APPENDIX II

Table 2 PERCENTAGE DISTRIBUTION OF STATE INCOME OF ORISSA BY INDUSTRIAL ORIGIN AND PER CAPITA INCOME AT CURRENT PRICES FROM 1960-61 to 1975-76

Sector/year (1)	1960-61 (2)	1961-62 (3)	1965-66 (4)	1968-69 (5)	1970-71 (6)	1971-72 (7)	1972-73 (8)	1973-74 (9)	1974-75 (10)	1975-76 (11)
A) Percentage Distribution:										
1) Agriculture and allied activities	61.3	59.1	56.6	63.6	67.9	67.1	70.6	71.4	69.6	68.5
2) Mining, manufacturing Small enterprises and construction	14.3	16.2	19.1	14.1	14.1	13.6	11.4	12.1	12.5	12.6
3) Commerce, transport & communication	7.8	7.7	7.7	8.0	8.0	8.4	7.9	7.7	7.6	7.4
4) Other services	16.6	17.0	16.6	14.7	10.00	10.9	10.1	8.8	10.3	11.5
	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00
B) Per Capita Income (Rs)	216.50	227.9	328.6	463.7	492.8	487.2	583.6	700.9	706.9	784.8

Source: "Economic Survey of Orissa, 1976", BSE, Government of Orissa, Bhubneswar, 1977.

ANNEXURE II
APPENDIX II
Table 3

EXPENDITURE ON IRRIGATION, FLOOD CONTROL & POWER GENERATION DURING PLAN PERIODS, ORISSA & ALL-INDIA

(Rupees in lakhs)

	Ist Plan	2nd Plan	3rd Plan	Annual Plans	Fourth Plan	Actual Exp. 1974-75	Fifth Plan (anticipated exp.of 75-76)
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
(a) ORISSA[1]							
i) Minor Irrigation	272.04	158.39	618.00	593.12	1,567.83	588.37	390.10
ii) Irrigation & Power							
1) Irrigation Projects (medium & major)	-	3,395.74	2,622.00	2,044.41	2,089.37	826.40	1,424.63
Total Expr. on Irrigation	272.04	3,554.13	3,240.00	2,637.53	3,657.20	1,414.77	1,814.73
2) Flood Control	-	-	294.00	100.63	232.00	70.00	275.37
3) Power Projects	481.55	575.63	5,171.00	3,316.82	11,911.62	2,726.07	4,423.00
iii) Percentage of total expr. on irrigation & power to total expr.	26.15	45.90	35.95	43.71	48.17	49.58	61.65
(b) INDIA[2]							
i) Irrigation projects (medium & major)	38,000.00	38,000.00	57,600.00	43,000.00	125,310.00	-	2,40,100 (tentative outlay of 5th Plan)
ii) Flood Control	1,320.00	4,510.00	8,210.00	4,200.00	16,200.00	-	30,100 (5th Plan outlay

Source: (1) Data for Orissa are taken from "Economic Survey of Orissa, 1976", BSE, Government of Orissa, Bhubaneswar, 1977.
(2) Data for India are taken from "Pocket Book on Major and Medium Irrigation", Central Water Commission, Government of India, New Delhi, 1976.

ANNEXURE II
APPENDIX II
Table 4

POTENTIAL AND UTILISATION- FROM ALL IRRIGATION PROJECTS, ORISSA & ALL-INDIA

(In thousand hactares)

i) Major and Medium Projects (cumulative including pre-plan)

State	Ultimate potential (approx.)	Pre-plan potential	To the end of the Ist Plan		To the end of the 2nd Plan		To the end of the 3rd Plan		To the end of Annual Plan		To theend of 4th Plan		%age of utilisation to the end of 4th Plan	5th plan target (potential)
			Pot.	Uti.	Pot.	Uti.	Pot.	Uti.	Pot.	Uti.	Pot.	Uti.		
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)
ORISSA	3,600	455	459	459	822	739	949	868	1,080	1015	1263	1219	96.44	240
INDIA	56,750	9,705	12,192	11006	14333	13064	16565	15176	18,125	16781	20900	18799	89.94	6217

ii) Minor Irrigation (area irrigated)

ORISSA		604	701		762		884		310		400		-	750

iii) Irrigation Potential Created by the end of 1974-75 Orissa.

Major irrigation		Medium irrigation		Minor (flow) irrigation		Minor (lift) irrigation		All sources		
Kharif	Rabi	Kharif	Rabi	Kharif	Rabi	Kharif	Rabi	Kharif	Rabi	Total
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)
554.07	178.20	53.23	6.46	611.13	52.54	105.11	40.31	1,323.52	297.53	1,601.05
(41.86)*	(64.02)	(4.02)	(2.32)	(46.17)	(18.93)	(7.94)	(14.52)	(82.66	(17.34)	

Source: (1) Iata for (i) and (ii) are taken from "Pocket Book on Major & Medium Irrigation", op. cit.

(2) Data for (iii) are taken from "Economic Survey of Orissa, 1976", op. cit.

(*) The figure in the brackets are the percentages of the total Kharif and Rabi irrigation respectively.

ANNEXURE II
APPENDIX II
Table 5

PROGRESS OF ELECTRICITY SUPPLY - ORISSA

Year ending (1)	12/51 (2)	12/56 (3)	3/61 (4)	3/66 (5)	3/69 (6)	3/74 (7)	3/75 (8)	3/76 (9)
Installed capacity (in MW)								
Hydro	0.01	24.01	123.01	304.44	304.42	424.43	544.42	604.42
Steam	0.78	5.78	5.78	5.78	195.75	258.25	258.25	258.25
Diesel	4.08	3.99	7.47	4.80	1.88	1.05	0.55	0.45
Total	4.87	33.78	136.26	314.99	501.85	683.73	803.22	863.12
Energy generation (Gross in Million KWH)								
Hydro	0.01	0.01	483.74	1155.52	997.57	1591.14	1470.00	2518.57
Steam	2.13	17.62	-	-	384.36	550.06	861.20	716.30
Diesel	4.67	3.52	5.90	0.97	0.95	0.43	0.04	0.06
Total	6.81	21.15	489.64	1156.49	1382.88	2114.63	2331.24	3234.93
Purchase from non-utilities	NA	NA	44.81	9.03	9.83	5.91	6.68	4.41
Used by power station auxiliaries	-	-	3.68	6.26	53.55	70.24	97.38	85.57

Source: Central Electricity Authority, Government of India, New Delhi, 1977.

ANNEXURE II
APPENDIX II
Table 6

GROWTH OF POWER & ENERGY, ORISSA & ALL INDIA

(Index of Growth with 1960-61 = 100)

A) Particulars/Year (1)	1960-61 (2)	1965-66 (3)	1969-70 (4)	1973-74 (5)	1974-75 (6)
A) Inscalled capacity					
i) Orissa	100	104.0	185.4	184.9	185.0
ii) India	100	180.3	276.8	328.5	358.9
B) Electricity Generated					
i) Orissa	100	245.1	341.3	425.3	353.0
ii) India	100	182.5	281.0	361.7	379.6

Source: "Economic Survey of Orissa, 1976", BSE, Op. cit.

ANNEXURE II
APPENDIX II
Table 7

CONSUMPTION OF ELECTRICITY IN ORISSA

Year	Total consumption (in MKWH)	Percentage of consumption as different sectors								
		Domestic	Commercial	Small& Medium Industries	Large industries	Public lighting	Irr.& Agr.	Railway traction	Public water works	Bulk supply
(1)	(2)	(3)	(4)	(5)	(6)	(70)	(8)	(9)	(10)	(11)
1961-62	556.44	1.85	0.79	1.83	87.23	0.24	0.02	2.66	0.29	5.18
1965-66	980.90	3.05	0.72	2.90	87.02	0.80	0.17	3.33	0.54	1.41
1969-70	1,331.27	2.63	2.97	4.11	83.92	0.49	0.32	2.30	0.71	2.50
1970-71	1,615.50	2.31	2.17	2.65	84.33	0.32	0.30	2.49	1.11	4.28
1971-72	1,660.58	2.13	2.05	2.47	84.94	0.32	0.32	3.66	1.19	2.87
1972-73	1,655.73	2.28	2.20	2.52	85.58	0.37	0.50	3.40	1.18	1.92
1973-74	1,844.01	2.56	2.21	2.37	71.19*	0.37	0.42	2.69	1.17	16.96
1974-75	1,995.11	2.44	2.20	2.73	68.76*	0.34	0.44	2.70	1.05	19.29
1975-76	2,517.65	2,45	1.86	73.26 *		0.31	0.35	-	1.64	20.70

Source: The percentages are derived by us from the data given in "Economic Survey of Orissa, 1976", BSE, Govt. of Orissa Bhubneswar, 1977.

* There was large curtailment of electric supply to the industries on account of fall of reservoir levels due to draught conditions in the State.

ANNEXURE II
APPENDIX II
Table 8

GROWTH OF ENERGY SALES AND SYSTEM DEMAND (1976-77 to 1983-84) , ORISSA

(percentages)

Sl.No. (1)	Particulars (2)	1976-77 (3)	1977-78 (4)	1978-79 (5)	1979-80 (6)	1980-81 (7)	1981-82 (8)	1982-83 (9)	1983-84 (10)
	Energy Sale (percentages of total sale)								
1)	Domestic light & small power	2.79	2.88	2.67	2.51	2.45	2.06	2.27	2.58
2)	Commercial light & Small power	2.39	2.40	2.15	1.92	1.79	1.44	1.52	1.63
3)	Public lighting	0.44	0.48	0.49	0.42	0.38	0.29	0.30	0.31
4)	Public water works & swerege pumping	1.15	1.08	0.98	0.82	0.75	0.56	0.57	0.58
5)	Irrigation & Dewatering.	0.48	0.60	0.65	0.66	0.68	0.58	0.64	0.72
6)	Industries:	88.41	88.40	88.28	89.71	88.56	92.57	92.28	91.76
	a) L.T.	3.05	3.24	3.03	2.86	2.80	2.36	2.62	2.96
	b) H.T. (less than 1 MW)	9.31	8.82	8.13	7.65	7.46	6.15	6.57	7.09
	c) H.T. (1MW & above)	76.05	76.34	77.12	79.20	80.30	84.06	83.09	81.71
7)	Railway/Trainway traction	3.32	3.20	3.92	3.21	2.73	1.99	1.92	1.89
8)	Bulk Supply to Non-industrial consumers	0.97	0.92	0.81	0.69	0.61	0.46	0.46	0.48
		100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00
9)	Total sales (in Million unit)	2,255	2,494	3,060	3,736	4,391	6,011	6,240	6,345

Source: The percentages are calculated from the data supplied by the OSEB, Bhubaneswar to CEA for Tenth Annual Electric Power Survey 1976-77.

ANNEX V(A)
Table 1

STATEMENT SHOWING FLOOD DAMAGES OF DHENKANAL SADAR BLOCK, DT.DHENKANAL

Year	No.of vill. affected	Population affected	Area affected (in acrs.)	Name of the river/nala which caused flood	% of damage caused by Brahmani System.	No. of private houses affected.	Valuation of losses to pr. houses (in Rs.)	No.of human casuality	No.of livestock casuality	Valuation of losses to livestock (in Rs.)	Valuation of damages to GP roads & etc. (in Rs.)
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
1970	28	9000	1830	Brahmani	100	-	-	-	-	-	-
1971	NA	NA	NA	Br.& Bg.	95	-	-	-	-	-	-
1972	77	26652	3141	Br.,S.,B.	05	370	39800	-	590	20770	-
1973	29	6444	1666	Br.,S.,B.	95	15	750	-	-	-	54700
1974	20	14164	1284	Brahmani	100	-	-	-	-	-	-
1975	28	18477	2762	Br.,B.&Gh.	98.5	178	129000	-	-	-	113800
1976	22	16337	1630	Brahmani	100	-	-	-	-	-	312000

Cultivated area affected (in acr)	Area sand casted.	Area water logged.	Crop losses (in Qtls)	Valuation of crop Losses (in Rs.)	Addl. gains during. Rabi (in Rs.)	Net crop losses (in Rs.)	Total losses due to floods (in Rs.)	Valuation of relief & grants (in Rs.)	Valuation of loans (in Rs.)	Valuation of losses and relief attributable to Brahmani system (in Rs.)
(13)	(14)	(15)	(16)	(17)	(18)	(19)	(20)	(21)	(22)	(23)
1796	81	20	4160	252470	63117	189353	189353	-	17400	189353 (238528)
1070	-	-	-	42800	10700	32100	32100	-	-	30495 (35569)
3141	246	-	279	19750	4937	14813	75383	-	-	3769 (4070)
1666	308	481	2675	194499	48625	145874	201324	58000	45625	246358 (246358)
1284	-	833	694	68387	17097	51290	51290	-	-	51290 (47490)
2762	325	2337	5594	686552	171638	514914	757715	26186	27500	772142 (661980)
1630	149	288	315	27049	6762	20287	332287	-	-	332287 (263779)
Average valuations							234207			232242 (213968)

ANNEX V(A)
Table 2

STATEMENT SHOWING FLOOD DAMAGES OF ODAPADA BLOCK, DT. DHENKANAL

(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
1970	27	6000	2899	Brahmani	100	-	-	-	-	-	-
1971	NA	NA	NA	Br.,L.& Bg.	95	-	-	-	-	-	-
1972	158	67551	2800	Br.,B.,S.. & L.	5	246	24600	-	670	64900	-
1973	65	38174	5453	Br.,L.,K.	95	262	17000	-	-	-	54700
1974	28	27271	1851	Br.	100	-	-	-	-	-	-
1975	40	31891	7537	Br.,L.& B.	98	1279	127900	-	4	600	113800
1976	32	28787	2812	Brahmani	100	-	-	-	-	-	57000
Average losses							24214			9357	32214

(13)	(14)	(15)	(16)	(17)	(18)	(19)	(20)	(21)	(22)	(23)
2894	83	15	7200	436968	109242	327726	327726	-	-	327726 (412836)
5274	NA	N.	-	210960*	52740	158220	158220	-	-	150309 (175320)
2800	10	-	360	25484	6371	19113	109283	-	-	5464 (5901)
9650	520	347	3121	226928	56732	170196	241896	56000	45624	283002 (283002)
1851	-	-	-	-	-	-	-	-	-	- -
7537	183	1295	29480	3618080	904520	2713560	2955860	27485	27500	2923678(2506557)
2812	25	905**	26	2233	558	1675	58675	-	-	58675 (46578)
Average losses						484356	550237	11926		535551 (490028)

* The valuation of crop losses are done on the basis of Rs.40 per acre, which was mentioned by the Collector, Dhenkanal in his final report.

** There was no loss in respect of A 905 and other areas as the flood water remained for 2-3 days.

Abbreviations: Br.-Brahmani, L.-Lingra, B.-Badajora, Bg.-Bangurisinganala, S.-Sapua, K.-Kisinda.

ANNEX V(A)

Table 3

STATEMENT SHOWING FLOOD DAMAGES OF GONDIA BLOCK, DT. DHENKANAL

(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
1970	59	10500	3782	Brahmani	100	1	100	-	-	-	-
1971	NA	NA	NA	Brahmani	100	-	-	-	-	-	-
1972	140	43126	7884	Br.& others	5	1987	223100	-	1119	288800	-
1973	21	6000	5453	Br.,Dh.&etc.	95	100	5000	-	-	-	54700
1974	47	11954	7289	Brahmani	100	-	-	-	-	-	-
1975	41	15598	8725	Br.,Dh.&etc.	98	1798	203050	-	3	150	113800
1976	33	7713	2530	Brahmani	100	8	1600	-	-	-	56500
Average losses							61835			41278	32143

(13)	(14)	(15)	(16)	(17)	(18)	(19)	(20)	(21)	(22)	(23)
3812	105	27	9340	566845	141711	425134	425234	-	19000	425234 (535667)
4260	-	-	-	170400	42600	127800	127800	-	-	127800 (149066)
7884	267	NA	1326	93868	23467	70401	582301	-	-	29115 (31444)
5453	150	487	2061	149855	37464	112391	172091	64000	45625	224286 (224286)
7289	15	6609	7321	721411	180353	541158	541158	-	-	541158 (501,069)
8725	761	3336	10570	1297256	324314	972942	1289942	30413	27500	1293948 (1109340)
1840	176	275	7460	640590	160147	480443	538543	-	-	538543 (427512)
Average losses						390038	525295	13344		454298 (425483)

Abbreviations: Br.-Brahmani, Dh.- Dhanianal, NA - Not available, '-':- Nil.

ANNEX V(A)
Table 4

STATEMENT SHOWING FLOOD DAMAGES OF TALCHER BLOCK,* DT. DHENKANAL

(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
1970	16	279	122	Si. & N.	0	-	-	-	-	-	42000
1971	-	-	-	-	-	-	-	-	-	-	-
1972	28	1350	270	rain, N.	0	-	-	-	-	-	-
1973	23	3185	1257	Br. & N., Si.	75	180	25000	-	-	-	-
1974	-	-	-	-	-	-	-	-	-	-	-
1975	21	6974	1892	Br. & N.	77	193	61100	-	17	136	113800
1976	-	-	-	-	-	-	-	-	-	-	-
Average losses							12300			19	16257

(13)	(14)	(15)	(16)	(17)	(18)	(19)	(20)	(21)	(22)	(23)
-	-	-	-	-	-	-	-	-	-	-
-	-	-	-	-	-	-	-	-	-	-
270	24	89	94	6690	1672	5018	5018	-	-	-
1257	279	978	4050	294475	73619	220856	245856	31500	45625	208017 (208017)
-	-	-	-	-	-	-	-	-	-	-
1733	268	1687	9122	1119543	279886	839657	1014693	25040	27500	800594 (685373)
-	-	-	-	-	-	-	-	-	-	-
Average losses						152219	180795	8077		144087 (127770)

The abbreviations: Br. - Brahmani, N.- Nandira & Si.- Singda

* Inclusive of the damages to Talcher Municipality.

ANNEX V(A)
Table 5

STATEMENT SHOWING FLOOD DAMAGES OF KANIHA BLOCK, DT. DHENKANAL

(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
1970	17	305	70	rains	0	-	-	-	-	-	30000
1971	-	-	-	-	-	-	-	-	-	-	-
1972	13	700	136	rains	0	-	-	-	-	-	-
1973	114	5863	3247	Br.,T.Sa.	75	56	3500	-	NA	3000	-
1974	-	-	-	-	-	-	-	-	-	-	-
1975	64	32190	5202	Br.Si.T.& Sa.	78	1001	145000	-	15	7500	113800
1976	-	-	-	-	-	-	-	-	-	-	-
Average losses							21214			1500	16257

(13)	(14)	(15)	(16)	(17)	(18)	(19)	(20)	(21)	(22)	(23)
N.A.	N.A.	N.A.	-	-	-	-	-	-	-	- -
-	-	-	-	-	-	-	-	-	-	-
136	6	10	28	2007	502	1505	1505	-	-	-
3247	633	2614	10374	754293	188573	565720	572220	45500	45625	463290 (463290)
-	-	-	-	-	-	-	-	-	-	-
3006	493	2616	13740	1686310	421577	1264733	1531033	26710	27500	199462 (1028335)
-	-	-	-	-	-	-	-	-	-	-
Average losses						261708	300680	10315	-	237536 (213089)

The Abreviations: Br.- Brahmani, Sa.Samakoi, T.-Tikira, & Si.- Singda

ANNEX V(A)
Table 6

STATEMENT SHOWING FLOOD DAMAGES OF PARAJANGA BLOCK, DT. DHENKANAL

(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
1970	32	5488	1421	Brahmani	100	7	2550	-	1	200	20000
1971	NA	NA	NA	Brahmani	100	-	-	-	-	-	-
1972	37	NA	NA	rains	-	-	-	-	8	1500	-
1973	39	11975	913	Br., DL. etc.	95	89	8650	-	-	-	-
1974	-	-	-	-	-	-	-	-	-	-	-
1975	28	11052	1920	Br. & G.	99	636	84000	-	13	1300	113000
1976	-	-	-	-	-	-	-	-	-	-	-
Average losses							13600			428	19114

(13)	(14)	(15)	(16)	(17)	(18)	(19)	(20)	(21)	(22)	(23)
1424	109	37	3151	191234	47808	143426	166176	670	3500	166816 (210176)
420	-	-	-	16800	4200	12600	12600	-	-	12600 (14697)
1236	-	-	180	12742	3185	9557	9557	-	-	-
913	326	587	3065	222856	55714	167142	167142	49000	45625	213552 (213552)
-	-	-	-	-	-	-	-	-	-	-
2825	154	-	3564	437410	109352	328058	328352	30485	27500	552067 (473304)
-	-	-	-	-	-	-	-	-	-	-
Average losses						94397	127397	11450		135009 (130247)

The Abbreviations: Br. - Brahmani, DL- Dadaranal & G. - Godadinal

ANNEX V(A)
Table 7

STATEMENT SHOWING FLOOD DAMAGES OF KAMAKSHYANAGAR BLOCK, DT.DHENKANAL

(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
1970	48	14099	2048	Br.& R.	50	20	500	-	-	-	31000
1971	NA	NA	NA	Br.& R.	50	-	-	-	-	-	-
1972	133	73813	35267	R.& rains	0	215	35150	-	1	300	-
1973	32	11798	481	Br.,R.&etc.	35	1283	352215	-	-	4950	-
1974	-	-	-	-	-	-	-	-	-	-	-
1975	62	13012	3760	Br.& R.	59	1336	121420	-	3	1500	113800
1976	1	100	136	Ramial	0	-	-	-	-	-	6500
Average losses							72755			964	21614

13)	(14)	(15)	(16)	(17)	(18)	(19)	(20)	(21(	(22)	(23)
2052	530	1837	10758	652907	138227	514680	546180	400	4200	273290 (344263)
750	-	-	-	30000	7500	22500	22500	-	-	11250 (13122)
35267	1378	1721	4810	340500	85125	255375	290825	-	-	-
481	361	120	1443	104921	26230	78691	435856	73000	45625	279871 (279871)
-	-	-	-	-	-	-	-	-	-	-
3777	85	155	10648	1306829	326707	980122	1216842	30835	27500	736130 (631106)
-	-	-	-	-	-	-	6500	-	-	-
Average losses						264481	359815	14891		185792 (181194)

Abbreviations: Br.-Brahmani, and R.- Ramial

STATEMENT SHOWING FLOOD DAMAGES OF BHUBAN BLOCK*, DT. DHENKANAL

ANNEX V(A)
Table 8

(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
1970	44	15890	4410	Br.&Dl.	80	-	-	-	-	-	-
1971	NA	NA	NA	Br.& R.	75	5	500	-	-	-	25000
1972	92	47441	21712	Dl.& rains	0	266	37200	-	27	4750	-
1973	44	12433	1377	Br.,R.&Dl.	50	359	60600	1	-	-	-
1974	-	-	-	-	-	-	-	-	-	-	-
1975	82	21856	14080	Br.& R.	52	1781	157685	6	-	-	113800
1976	-	-	-	-	-	-	-	-	-	-	-
Average losses							36569			678	19828

13)	(14)	(15)	(16)	(17)	(18)	(19)	(20)	(21)	(22)	(23)
4410	1894	3016	1517	92067	23017	69050	94050	-	6800	75240 (94780)
980	NA	N..	-	39200	9800	29400	29900	-	-	22425 (26157)
21712	374	894	2592	183488	45872	137616	179566	-	-	-
1377	607	770	4738	344500	86125	258375	318975	71000	45625	194987 (194987)
-	-	-	-	-	-	-	-	-	-	-
14071	1870	270	19832	2433981	608495	1825486	2096971	46860	27500	1114792 (955745)
-	-	-	-	-	-	-	-	-	-	-
Average losses						331418	388494	16837		201063 (181667)

Abbreviations: Br.- Brahmani, Dl.-Damasal, & R. - Ramial., * Inclusive of Bhuban NAC.

Note for Annex V(A): i) The damages data have been collected from the diff. TDR files of the office of the Collector, (Emergency Section), Dhenkanal, Orissa.

ii) Figures in column (6) have been derived by us on the basis of the information collected from diff. field officials of Agr. Department.

iii) The crop losses have been estimated by us by multiplying the loss of yield in terms of Paddy and the average wholesale prices, collected from Food and Civil Supplies Department, Govt. of Orissa.

iv) With respect to figures in column (18), we have assumed it to be 25% of the crop losses on the basis of our information & observations in the field.

v) Figures in brackets in column(23) are the values at base year prices.

ANNEX V(B)
Table 9

STATEMENT SHOWING FLOOD DAMAGES OF SUKINDA BLOCK, DT. CUTTACK

(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
1969	NA	NA	NA	NA	100	41	41000	NA	NA	NA	NA
1970	NA	NA	NA	NA	100	-	-	NA	NA	NA	NA
1971	NA	NA	NA	NA	100	183	2055	NA	NA	NA	NA
1972	25	16300	7.03	Br. & P.	100	114	9750	Nil	44	4800	-
1973	34	9200	9.00	Br.Kh.Ku.&P	95	440	85500	1	8	1600	180000
1974	-	-	-	-	-	-	-	-	-	-	-
1975	31	12425	25.00	Br.& P.	100	491	78100	-	1	350	60750
1976	-	-	-	-	-	-	-	-	-	-	-
1977	20	18238	30.00	Br.&P.	100	-	-	-	-	-	27500
Average losses							24045			750	32022

(13)	(14)	(15)	(16)	(17)	(18)	(19)	(20)	(21)	(22)	(23)
44	NA	NA	NA	1800	450	1350	42350	2850	6450	45100 (61354)
5136	-	-	-	256800	64200	192600	192600	-	-	192600 (242618)
3526	-	-	-	109390	27347	82043	84098	10000	NA	94098 (109756)
4500	30	-	90	6371	1593	4778	19328	791	NA	20119 (21729)
6100	170	1610	3866	281097	70274	210823	477923	5280	NA	459043 (459043)
-	-	-	-	-	-	-	-	-	-	-
3389	393	484	8540	1048114	262028	786086	925236	19499	NA	944735 (809950)
-	-	-	-	-	-	-	-	-	-	-
6034	200	850	590	52646	13161	39485	66985	11004	NA	77989 (57233)
Average losses						146352	203169	5492		204409 (195753)

The Abbreviations: Kh.- Kharasrota, Ku.- Kusavadra, P.- Pandaranal. However, Kh. and P. are parts of the Brahmani system.

Note for columns of Annex V(B) : (1) The figures in column (5) are expressed in terms of sq. miles. (ii) Figures in column(12) include the damages to roads, embankments, MIPs, Govt. Buildings and other public properties.

ANNEX V(B)
Table 10

STATEMENT SHOWING FLOOD DAMAGES OF DANAGADI BLOCK* ,DT. CUTTACK

(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
1969	-	-	-	-	100	64	64000	NA	NA	NA	NA
1970	NA	NA	NA	NA	100	-	-	NA	NA	NA	NA
1971	NA	NA	NA	NA	100	266	43500	-	-	-	NA
1972	62	24480	9.40	Kh.,Ku.&Ga.	95	226	16900	-	47	6200	-
1973	19	6371	7.00	Br.Kh.Ku.&Ga.	95	301	100800	-	-	-	160000
1974**	-	-	-	-	-	-	-	-	-	-	-
1975	55	11249	22.00	Br.Ga.& K.	96	1640	118900	-	-	-	389150
1976**	-	-	-	-	-	-	-	-	-	-	-
1977	13	6924	4.50	Br. & Kh.	100	-	-	-	-	-	15000
Average losses							38278			688	62383

(13)	(14)	(15)	(16)	(17)	(18)	(19)	(20)	(21)	(22)	(23)
57	-	-	-	2400	600	1800	65800	8650	10000	74450 (101282)
3440	-	-	-	217000	54250	162750	162750	NA	N..	162750 (205016)
3839	-	-	-	147810	36952	110858	154358	9300	NA	163658 (190891)
6000	200	300	1500	106185	26546	79639	102739	791	-	98354 (106222)
5000	150	1427	2048	148910	37228	111682	372482	6644	-	360169 (360169)
-	-	-	-	-	-	-	-	-	-	-
5203	55	2700	25536	3134033	783508	2350525	2858575	47205	-	2789549 (2391564)
-	-	-	-	-	-	-	-	-	-	-
350	20	350	800	71384	17846	53538	68538	3668	-	72206 (53073)
Average losses						318977	420582	8473		413460 (378691)

The Abbreviations: - Ga.- Gandanal, & K. - Kusia.
* Inclusive of the damages to Jajpur Road NAC.
** There were moderate floods in these years, but no damages were caused.

ANNEX V(B)
Table 11

STATEMENT SHOWING FLOOD DAMAGES OF KOREI BLOCK, DT. CUTTACK

(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
1969	NA	NA	NA	NA	-	NA	NA	NA	NA	NA	NA
1970	NA	NA	NA	NA	-	NA	NA	NA	NA	NA	NA
1971	NA	NA	NA	NA	-	NA	NA	NA	NA	NA	NA
1972	83	38522	46.00	Bai.&Kh.	25	233	18650	-	91	9800	-
1973	59	23345	7.00	Bai.Kh.&Bu.	30	1060	186000	-	5	1000	100000
1974	28	9892	NA	Kh.&Bai.	30	-	-	-	-	-	-
1975	87	47411	96.00	Bai.& Kh.	35	6632	683500	1	-	-	326300
1976	-	-	-	-	-	-	-	-	-	-	-
1977	20	8978	15.50	Kh.	100	-	-	-	-	-	41000
Average losses							98683			1200	51922

(13)	(14)	(15)	(16)	(17)	(18)	(19)	(20)	(21)	(22)	(23)
NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
29535	50	1200	3750	265462	66363	199099	227549	15819	-	60842 (65709)
4746	410	2305	5569	404922	101230	303692	590692	27899	-	185577 (185577)
182	-	-	227	22369	5592	16777	16777	-	-	5033 (4660)
17348	1647	3547	72324	8876325	2219081	6657244	7667044	124394	NA	2727003 (2337941a)
-	-	-	-	-	-	-	-	-	-	-
5685	-	2700	6075	542072	135518	406554	447554	18341	NA	465895 (342442)
Average losses						842596	994402	20717		574058 (489388)

Abbreviations: Bai.- Baitarani, Bu. - Budha, Kh. - Kharsrota or Kharsuan.

Note: The additional gains during Rabi season for Korei, Danagadi, & Sukinda blocks are assumed to be 25% of the cropp losses. These assumptions are based on our information from the respective AEOs of the blocks.

ANNEX V(B)
Table 12

STATEMENT SHOWING FLOOD DAMAGES OF RASULPUR BLOCK, DT. CUTTACK

(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
1969	NA	NA	NA	NA	100	656	13940	NA	NA	NA	NA
1970	NA	NA	NA	NA	100	38	7415	NA	NA	NA	NA
1971	NA	NA	NA	NA	100	5200	865775	NA	NA	NA	NA
1972	88	81780	40.00	Br.& Kh.	100	218	21550	-	80	4150	26000
1973	151	90000	40.00	Br.,Kh.& Ke.	100	4326	1357400	5	2	400	110000
1974	71	38136	NA	Br.& Kh.	100	20	4000	-	-	-	-
1975	151	89000	175.00	Br.,Kh.& Ke.	100	9087	2506260	7	1480	61300	1558500
1976	NA	NA	NA	NA	100	-	-	-	-	-	3000
1977	111	36233	17.00	Br.& Kh.	100	-	-	-	-	-	61500
Average losses							530704			7317	195444

(13)	(14)	(15)	(16)	(17)	(18)	(19)	(20)	(21)	(22)	(23)
200	-	-	-	20000	6000	14000	27940	NA	NA	27940 (38010)
3330	-	-	-	1914500	574350	1340150	1347565	NA	NA	1347565(1697528)
37128	-	-	-	3712800	1113740	2599060	3464835	21000	NA	3485835(4065878)
25220	130	2500	7890	558533	167560	390973	442673	17524	-	460197 (497013)
25711	3150	8680	24381	1772743	531823	1240920	2708720	147456	NA	2856176(2856176)
985	-	-	1231	121303	36391	84912	88912	-	-	88912 (82325)
-	-	-	-	-	-	-	3000	-	-	3000 (2381)
11352	250	11352	33460	298536	895691	2090945	2152445	28041	NA	2180486(1602701)
Average losses						1559279	2292867	39514		2332381(2208822)

The Abbreviations: Ke.- Kelua (however, Kelua is a part of the Brahmani system)

ANNEX V(B)

Table 13

STATEMENT SHOWING FLOOD DAMAGES OF DHARMASHALA BLOCK, DT.CUTTACK

(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
1969	NA	NA	NA	NA	100	1023	21660	NA	NA	NA	NA
1970	NA	NA	NA	NA	100	33	7150	NA	NA	NA	NA
1971	NA	NA	NA	NA	100	5400	466000	NA	NA	NA	NA
1972	74	28975	51.90	Br.Ke.&Ge.	80	278	25850	-	18	900	-
1973	78	36150	35.00	Br.& P.	100	2585	780000	1	4	800	225000
1974	37	15318	NA	Br.	100	-	-	-	-	-	-
1975	163	80000	149.00	Br.Ke.&Ge.	90	6592	960015	4	140	14100	1201000
1976	NA	NA	NA	Br.	100	-	-	-	-	-	2000
1977	89	43510	24.00	Br.Ke.&Ge.	80	-	-	-	-	-	98000
Average losses							251186			1756	169555

13	(14)	(15)	(16)	(17)	(18)	(19)	(20)	(21)	(22)	(23)
536	-	-	-	53600	16080	37520	59180	NA	NA	59180 (80508)
8068	-	-	-	1921500	576450	1345050	1352200	NA	NA	1352200 (1703366)
15912	-	-	-	1510000	453000	1057000	1523000	20000	-	1543000 (1799755)
33236	100	2000	6300	445977	133793	312184	338934	12166	-	280880 (303350)
17653	1005	7250	9231	671186	201356	469830	1475630	85129	-	1560759 (1560759)
677	-	-	1046	103073	30922	72151	72151	-	-	72151 (66807)
26728	1822	24906	112115	13759874	4127962	9631912	11807027	136982	NA	10749608 (9215961)
-	-	-	-	-	-	-	2000	-	-	2000
15377	68	15377	6829	609352	182806	426546	524546	57844	NA	465912 (342455)
Average losses						1483577	1905852	34680		1787077 (1674733)

The Abbreviations: - Ge.- Ganguti.

Note:- The additional gains during Rabi season for both Rasulpur and Dharmasala blocks are assumed to be 30% of the crop losses.

ANNEX V(B)
Table 14

STATEMENT SHOWING FLOOD DAMAGES OF BADACHANA BLOCK, DT. CUTTACK

(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
1969	NA	NA	NA	NA	100	380	38000	NA	NA	NA	NA
1970	NA	NA	NA	NA	100	82	72050	NA	NA	NA	NA
1971	NA	NA	NA	NA	100	2500	114825	NA	NA	NA	NA
1972	76	42140	16.35	Bir.Ke.&Ge.	80	225	19250	-	88	5100	30000
1973	83	60449	31.00	Ke.& Bir.	67	786	284000	-	-	-	220000
1974	39	25622	NA	Br.&Ke.	100	-	-	-	-	-	-
1975	95	71435	143.00	Ke.Ka.Ge. Bir.& Go.	82	5850	2323600	1	10	3000	847500
1976	-	-	-	-	-	-	-	-	-	-	-
1977	114	63673	53.00	Bir.Ge.Ke. and Go.	80	-	-	-	-	-	112500
Average losses							316858			900	134444

(13)	(14)	(15)	(16)	(17)	(18)	(19)	(20)	(21)	(22)	(23)
500	-	-	-	50000	12500	37500	75500	NA	NA	75500 (102710)
7060	-	-	-	2376748	594187	1782561	1854611	NA	NA	1854611 (2336253)
3683	-	-	-	1392600	348150	1044450	1159275	27000	NA	1186275 (1383671)
10717	100	3000	9300	658347	164587	493761	548110	16512	-	451699 (437834)
19607	1000	3398	9726	707177	176734	630383	1134383	70373	-	807187 (807187)
651	-	-	814	80212	20053	60159	60159	-	-	60159 (55702)
19739	1072	18671	114389	14038962	3509740	10529222	13703322	119563	NA	11334766 (9717635)
-	-	-	-	-	-	-	-	-	-	-
33914	150	17089	34462	3075044	768761	2306283	2418783	38862	NA	1966116 (1445135)
Average losses						1876035	2328238	30257		1970701 (1815125)

Abbreviations: - Bir.- Birupa, Go.- Gobari, Ka.- Kani.

Note: The additional gains during Rabi season are assumed to be 25% of the crop losses.

ANNEX V(B)
Table 15

STATEMENT SHOWING FLOOD DAMAGES OF JAJPUR BLOCK, DT. CUTTACK

(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
1969	NA	NA	NA	NA	100	500	40000	NA	NA	NA	NA
1970	NA	NA	NA	NA	100	250	250000	NA	NA	NA	NA
1971	NA	NA	NA	NA	100	1409	160000	NA	NA	NA	NA
1972	146	71171	51.20	Bai.Kh.Bu. & J.	60	188	22200	-	42	4000	20000
1973	155	73247	72.00	Bai.: Bu.Kh. & J.	65	4934	869400	-	30	6000	100000
1974	72	31037	NA	Bai.Bu.& Kh.	50	-	-	-	-	-	-
1975	155	75466	153.00	Br.Kh.Bai. & Bu.	63	12654	2618930	2	125	5000	843000
1976	-	-	-	-	-	-	-	-	-	-	-
1977	79	30321	20.00	Br.& Kh.	100	-	-	-	-	-	528000
Average losses							440059			1667	165667

(13)	(14)	(15)	(16)	(17)	(18)	(19)	(20)	(21)	(22)	(23)
10000	-	-	-	2000000	600000	400000	440000	32945	-	472945 (2003794)
7000	-	-	-	1600000	480000	1120000	1370000	32945	-	1402945 (1767290)
12260	-	-	-	1265000	379500	985500	1150500	22500	-	1172500 (1367604)
32780	100	2000	6300	445977	133793	312184	358384	26184	NA	230740 (249199)
40096	1500	37000	22600	1643246	492974	1150272	2125672	65021	NA	1423950 (1423950)
1536	-	-	1536	151357	45407	105950	105950	-	-	52975 (49051)
30108	1943	6169	93502	11475500	3442650	8032850	11499780	112870	NA	7315970 (6272201)
-	-	-	-	-	-	-	-	-	-	-
18462	102	13699	67321	6007053	1802115	4204938	4732938	26023	NA	4758961 (3497932)
Average losses						1923522	2531469	35388		1981220 (1847891)

Abbreviations: - J.-Jamuna, Bu.- Budha.

ANNEX V(B)
Table 16

STATEMENT SHOWING FLOOD DAMAGES OF BARI BLOCK, DT. CUTTACK

(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
1969	NA	NA	NA	NA	100	1000	550000	NA	NA	NA	NA
1970	NA	NA	NA	NA	100	1000	550000	NA	NA	NA	NA
1971	NA	NA	NA	NA	100	4898	439550	NA	NA	NA	NA
1972	85	73044	52.00	Br.& Kh.	100	186	14150	-	20	800	-
1973	105	92000	55.00	Br. & Kh.	100	1316	242000	-	-	-	300000
1974	50	38983	NA	Br. & Kh.	100	22	4400	-	-	-	-
1975	105	90011	177.00	Br.Kh.&Bir.	80	12143	4340260	1	123	12000	1769000
1976	-	-	-	-	-	-	-	-	-	-	-
1977	93	83000	60.00	Br.Kh.Bir. Ke.,etc.	85	-	-	-	-	-	93700
Average losses							682262			1422	240300

(13)	(14)	(15)	(16)	(17)	(18)	(19)	(20)	(21)	(22)	(23)
20000	-	-	-	4000000	1200000	2800000	3350000	-	-	3350000 (4557340)
17564	-	-	-	1891000	567300	1323700	1873700	NA	NA	1873700 (2360300)
30150	-	-	-	3015000	904500	2110500	2550050	22500	-	2572550 (3000622)
33248	200	4000	12600	891954	267586	624368	639318	24114	-	663432 (716507)
34938	1670	30000	23850	1734134	520240	1213894	1755894	152770	NA	1908664 (1908664)
1338	-	-	1672	164759	49428	115331	119731	-	-	119731 (110861)
33990	1932	2760	94195	11560552	3468165	8092387	14213647	140599	NA	11483396 (9845060)
-	-	-	-	-	-	-	-	-	-	-
25965	300	24900	56423	5034624	1510387	3524237	3617937	76266	NA	3140073 (2308016)
Average losses						2200490	3124475	46250		2790172 (2756375)

The Abbreviations: Bir.- Birupa , Ke.- Kelua.

ANNEX V(B)
Table 17

STATEMENT SHOWING FLOOD DAMAGES OF BINJHARPUR BLOCK, DT. CUTTACK.

(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
1969	NA	NA	NA	NA	100	700	350000	NA	NA	NA	NA
1970	NA	NA	NA	NA	100	500	100000	NA	NA	NA	NA
1971	NA	NA	NA	NA	100	785	82800	NA	NA	NA	NA
1972	38	37964	40.00	Kh. & Nu.	100	122	8250	-	16	650	-
1973	40	22046	23.00	Kh. & Nu.	100	342	66800	-	-	-	110000
1974	19	9341	NA	Kh.	100	-	-	-	-	-	-
1975	43	45686	85.00	Kh.Nu.&Ka.	100	1728	224290	-	38	5500	701000
1976	-	-	-	-	-	-	-	-	-	-	-
1977	42	45810	35.00	Kh.Nu.& Ka.	100	3	10000	-	-	-	60000
Average losses							93571			683	96778

(13)	(14)	(15)	(16)	(17)	(18)	(19)	(20)	(21)	(22)	(23)
10000	-	-	-	3500000	1050000	2450000	2800000	NA	NA	2800000 (3809120)
7038	-	-	-	1596475	478942	1117533	1217533	NA	NA	1217533 (1533726)
15800	-	-	-	1580000	474000	1106000	1188800	22500	-	1211300 (1412860)
25000	20	2000	6060	428987	128696	300291	309191	14565	-	323756 (349656)
14675	320	910	10100	734371	220311	514060	690860	33012	-	723872 (723872)
563	-	-	704	69372	20812	48560	48560	-	-	49560 (44963)
13441	1003	1822	54722	6716031	2014809	4701222	5632012	60519	-	5692531 (4880378)
-	-	-	-	-	-	-	-	-	-	-
9813	420	7110	21252	1896316	568895	1327421	1397421	55390	-	1452811 (1067845)
Average losses						1285010	1476042	20665		1496707 (1535824)

Abbreviations: Nu.-Nuamahara, Ka.- Kani (however, Nu.& Ka. are parts of the Brahmani system).

Note: The additional gains during the Rabi season are assumed to be 30% of the crop losses for Jajpur, Bari & Binjharpur blocks.

ANNEX V(B)
Table 18

STATEMENT SHOWING FLOOD DAMAGES OF DASARATHPUR BLOCK, DT. CUTTACK.

(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
1969	NA	NA	NA	NA	-	NA	NA	NA	NA	NA	NA
1970	NA	NA	NA	NA	-	NA	NA	NA	NA	NA	NA
1971	NA	NA	NA	NA	-	NA	NA	NA	NA	NA	NA
1972	40	40410	43.75	Bai.& Ka.	15	177	14300	-	14	1000	34000
1973	45	44874	75.00	Bai.& Ka.	20	399	47900	-	-	-	275000
1974	21	19014	NA	Bai.& Ka.	20	-	-	-	-	-	-
1975	54	57128	108.00	Bai.Kh.&Ka.	25	737	140275	-	-	-	695000
1976	-	-	-	-	-	-	-	-	-	-	-
1977	40	26867	26.00	Bai.Kh.&Ka. etc.	25	-	-	-	-	-	164500
Average losses							33746			-	194750

(13)	(14)	(15)	(16)	(17)	(18)	(19)	(20)	(21)	(22)	(23)
NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
28000	50	3000	9150	647729	161932	485897	535197	20564	-	83364 (90033)
9707	36	1500	10900	792539	198135	594404	917304	41714	-	191804 (191804)
373	-	-	373	36755	9189	27566	27566	-	-	5513 (5104)
21633	98	3267	58209	7143991	1785998	5357993	6193268	74224	NA	1566873 (1343327)
-	-	-	-	-	-	-	-	-	-	-
18290	80	8421	25130	2242350	560587	1681763	1046263	33752	NA	470004 (345462)
Average losses						1357937	1586600	28376		386260 (329288)

The Abbreviations: Bai.- Baitarani, Ka.- Kani.

NOTE:- The additional gains during Rabi season are assumed to be 25% of the crop losses.

ANNEX V(B)
Table 19

STATEMENT SHOWING FLOOD DAMAGES OF KENDRAPARA BLOCK, DT. CUTTACK

(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
1969	NA	NA	NA	NA	100	206	10400	NA	NA	NA	NA
1970	NA	NA	NA	NA	100	-	-	NA	NA	NA	NA
1971	NA	NA	NA	NA	100	500	50000	NA	NA	NA	NA
1972	6	4431	1.50	Brahmani	100	-	-	-	-	-	-
1973	28	21801	19.00	Br.L.& Go.	60	30	4700	-	-	-	38400
1974	18	16310	NA	Brahmani	100	-	-	-	-	-	-
1975	117	80527	19.00	Br.Go.L.& Bir.	06*	904	518990	-	20	1500	555500
1976	-	-	-	-	-	-	-	-	-	-	-
1977	-	-	-	-	-	-	-	-	-	-	-
Average losses							64899			165	65966

(13)	(14)	(15)	(16)	(17)	(18)	(19)	(20)	(21)	(22)	(23)
80	-	-	-	24000	6000	18000	28400	NA	NA	28400 (38635)
830	-	-	-	87000	21750	65250	65250	NA	NA	65250 (82195)
2000	-	-	-	200000	50000	150000	200000	NA	NA	200000 (233280)
980	-	780	3900	276081	69020	207061	207061	NA	NA	207061 (223626)
980	50	494	2060	149783	37446	112337	155437	-	-	93262 (93262)
67	-	-	134	13203	3301	9902	9902	5280	-	15182 (14057)
15259	540	2924	NA	6522444	1630611	4891833	5967823	16399	-	359053 (307827)
-	-	-	-	-	-	-	-	-	-	-
-	-	-	-	-	-	-	-	-	-	-
Average losses						606042	737097	2409		107579 (110320)

Abbreviations: L.- Luna, Go.- Gobari.

* As reported by the AEO, Kendrapara, the major damages in 1975 had been caused due to breach of embankment in the Luna river, which is a part of the Mahanadi system.

ANNEX V(B)
Table 20

STATEMENT SHOWING FLOOD DAMAGES OF DERABISI BLOCK, DT. CUTTACK

(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
1969	NA	NA	NA	NA	-	NA	NA	NA	NA	NA	NA
1970	NA	NA	NA	NA	-	NA	NA	NA	NA	NA	NA
1971	NA	NA	NA	NA	-	NA	NA	NA	NA	NA	NA
1972	7	1918	1.10	Br.	100	-	-	-	-	-	-
1973	39	25101	20.00	Br.& Bir.	5	17	2400	-	-	-	6700
1974	24	18765	NA	Brahmani	100	-	-	-	-	-	-
1975	115	51254	18.00	Br.Co.L.& Bir.	10	222	14100	-	-	-	208500
1976	-	-	-	-	-	-	-	-	-	-	-
1977	-	-	-	-	-	-	-	-	-	-	-
Average losses							2750			-	35867

(13)	(14)	(15)	(16)	(17)	(18)	(19)	(20)	(21)	(22)	(23)
NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
750	-	680	3400	240686	60171	180515	180515	-	-	180515 (194956)
1760	65	1660	3520	255939	63985	191954	201054	1056	-	10106 (10106)
120	-	-	240	23650	5912	17738	17738	-	-	17738 (16424)
11877	-	4641	NA	4184055	1046014	3138041	3360641	4763	-	336064 (288118)
-	-	-	-	-	-	-	-	-	-	-
-	-	-	-	-	-	-	-	-	-	-
Average losses						588041	626658	970		90737 (84934)

NOTE: The additional gains during Rabi season are assumed to be 25% of the crop losses for both Kendrapara and Derabisi blocks.

ANNEX V(B)
Table 21

STATEMENT SHOWING FLOOD DAMAGES OF PATTAMUNDAI BLOCK, DT. CUTTACK

(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
1969	NA	NA	NA	NA	100	491	24788	NA	NA	NA	NA
1970	NA	NA	NA	NA	100	106	36500	NA	NA	NA	NA
1971	NA	NA	NA	NA	100	1200	200000	NA	NA	NA	NA
1972	30	36232	23.50	Brahmani	100	7	7000	-	-	-	8500
1973	34	4524	25.00	Br.& Kh.	100	183	29120	-	-	-	53600
1974	21	3384	NA	Br.& Kh.	100	8	8000	-	-	-	-
1975	152	114844	62.00	Br. & Go.	80	11500	8026900	12	242	42000	2536500
1976	-	-	-	-	-	-	-	-	-	-	-
1977	38	53681	72.00	Brahmani	100	-	-	-	-	-	269500
Average losses							925812			4644	318678

(13)	(14)	(15)	(16)	(17)	(18)	(19)	(20)	(21)	(22)	(23)
1748	-	-	-	823050	246915	576135	600923	NA	NA	600923 (817496)
15420	-	-	-	1101030	330309	770721	807221	NA	NA	807221 (1016856)
3000	-	-	-	300000	90000	210000	410000	NA	NA	410000 (478224)
15055	-	-	2700	191133	57340	133793	149293	14500	-	163793 (176896)
17638	1133	1927	32110	2334718	700415	1634303	1717023	105414	-	1822437 (1822437)
1204	-	-	1800	177372	53212	124160	132160	-	-	132160 (122370)
50168	2592	35023	NA	31329337	9398801	21930536	32535936	253881	NA	26231854 (21702400)
-	-	-	-	-	-	-	-	-	-	-
15812	1025	4730	NA	3290100	977030	2313070	2582570	81332	N..	2663902 (1958021)
Average losses						3075858	4326125	50570		3648032(3121633)

ANNEX V(B)
Table 22

STATEMENT SHOWING FLOOD DAMAGES OF AUL BLOCK, DT. CUTTACK

(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
1969	NA	NA	NA	NA	100	1034	26070	NA	NA	NA	NA
1970	NA	NA	NA	NA	100	137	42900	NA	NA	NA	NA
1971	NA	NA	NA	NA	100	1000	15000001	NA	NA	NA	NA
1972	116	74449	19.00	Br. & Kh.	100	-	-	-	-	-	20000
1973	110	73544	58.00	Br.Kh.& Ka.	100	2984	253150	-	1	200	1107000
1974	70	55008	NA	Br.& Kh.	100	9	8500	-	-	-	-
1975	124	90702	62.00	Br.Kh.& Ka.	100	5419	3609250	2	6	1200	706000
1976	37	30660	NA	Br.& Kh.	100	-	-	-	-	-	2000
1977	46	41862	22.00	Br. & Kh.	100	10	4300	-	-	-	79000
Average losses							604908			1555	212667

(13)	(14)	(15)	(16)	(17)	(18)	(19)	(20)	(21)	(22)	(23)
41815	-	-	-	5092225	1527667	3564558	3590628	NA	NA	3590628 (4884690)
16286	-	-	-	1225800	367740	858060	900960	NA	NA	900960 (1134939)
10000	-	-	-	5000000	1500000	3500000	5000000	NA	NA	5000000 (5832000)
12261	20	21371	40256	2849722	854917	1994805	2014805	24000	-	2038805 (2201909)
35826	655	3269	64431	4684778	1405433	3279345	4639695	110771	NA	4750466 (4750466)
2440	-	-	3669	360656	108197	252459	260959	-	-	260959 (241627)
41407	1939	14327	94609*	11611363	3483409	8127954	12444404	72557	N..	12516961 (10731166)
13652	-	-	13652**	1172297	351689	820608	822608	-	-	822608 (653011)
5304	125	1934	NA	306900	92070	214830	298130	71009	-	369139 (271325)
Average losses						2512514	3330283	30926		3361169 (3411237)

* This loss to crop figures were missing in the data sheet and hence, in order to simplify the problem we have resorted to a method of approximation on the basis of 75% damages to crops and 50% damages to crops, which were available in the collector's report.

** Approximated on the basis of the report that there was below 25% losses to the cropped area affected, thus, it is assumed to be one quintal per acre.

STATEMENT SHOWING FLOOD DAMAGES OF RAJNAGAR BLOCK, DT. CUTTACK

ANNEX V(B)
Table 24

(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
1969	NA	NA	NA	NA	-	NA	NA	NA	NA	NA	NA
1970	NA	NA	NA	NA	-	NA	NA	NA	NA	NA	NA
1971	NA	NA	NA	NA	-	NA	NA	NA	NA	NA	NA
1972	24	13507	3.20	Br.& Hansua	100	-	-	-	-	-	-
1973	38	16077	5.00	Br.& Hansua	100	16	7300	-	-	-	201000
1974	24	12023	NA	Brahamani	100	-	-	-	-	-	-
1975	91	30602	35.00	Br.& Hansua	100	1680	155525	-	2	700	368500
1976	-	-	-	-	-	-	-	-	-	-	-
1977	23	14160	12.00	Br.& Hansua	100	17	28000	-	-	-	132100
Average losses							31804			116	116933

(13)	(14)	(15)	(16)	(17)	(18)	(19)	(20)	(21)	(22)	(23)
NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
8280	NA	NA	39407	2789622	836886	1952736	1952736	800	-	1953536(2109819)
8899	-	-	5160	375184	112555	262629	470929	103839	-	576768(576768)
607	-	-	380	37445	11233	26212	26212	-	-	26212(24270)
5842	18	NA	NA	369175	110752	258423	783148	77379	NA	860527(737756)
-	-	-	-	-	-	-	-	-	-	-
4870	-	-	-	93300	27990	65310	225410	46216	NA	271626(199651)
Average losses						427552	576406	38372		614778(698044)

General Note for AnnexV(B):

(i) The data for 1969-71 are collected from the office of the Addl. Chief Engineer (Irri.) Orissa. However, the percentages in column (6) are our own assumptions.

(ii) The data for 1972-77 are collected from different DR files of the Collector, Cuttack (Emergency Section) and the respective percentages in column (6) are collected from the BDOs of the various blocks.

(iii) Figures in column (21) are derived by **multiplying the relief** and the av. wholesale prices for each year, collected from the Food and Civil Supplies Dept., Govt. of Orissa.

(iv) Figures within brackets in column (23) are the valuations at base year prices.

ANNEX V(C)
Table 25

PUBLIC PROPERTIES DAMAGED DUE TO FLOODS IN THE BRAHMANI SYSTEM, DISTRICT DHENKANAL

(Figures in lakh Rs.)

Year	Damages to embankments (Rev. + Irrigation)	Damages to REO roads	Damages to PWD roads	Damages to Public Buildings	Damages to Edn. Institutions.	Damages to L.I. Points.	Damages to PHD	Damages to NAC & Municipalities	Total Damages
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
1970	-	-	1.90	-	-	NA	-	-	1.90 (2.39)
1971	-	-	-	-	-	NA	-	-	-
1972	-	-	-	-	-	NA	-	-	-
1973	0.53	-	7.074	-	0.282	NA	-	-	7.886(7.886)
1974	-	-	-	-	-	-	-	-	-
1975	4.485	2.11	5.104	0.56	1.528	2.211	0.162	0.775	16.936(14.519)
1976	0.64	-	5.465	-	0.206	0.34	0.25	-	6.901(5.479)
1977	-	-	3.675	-	-	2.686	-	-	6.361(4.675)
				Average annual losses to public properties					4.998(4.369)

Source:

1) The damages to embankments are collected from the Executive Engineer (Irrigation), Angul and for revenue embankments from the Collector's Report.
2) The REO road damages are collected from the Exe.Engr. (REO), Dhenkanal.
3) The damages to PWD roads and buildings are collected from the Collector's report and subsequently supported by the data collected from the Exe. Engr. PWD (R&B),DKL.
4) The damages to Edn. Institutions are collected from the office of the CI of schools, Dhenkanal and DI of Schools, Dhenkanal.
5) The damages to LI points are collected from Exe. Engr.(Lift Irrigation), Dhenkanal.
6) The damages to PHD, NAC/Municipalities are taken from the Collector's report.

Notes: The figures within brackets in the column, 10 are the valuations at base year prices.

ANNEX V(C)
Table 26

LOSSES TO CENTRAL GOVERNMENT ORGANIZATIONS DUE TO FLOODS IN BRAHMANI SYSTEM

(Figures in lakh Rs.)

Name of the organization that sustained losses due to floods.	Losses for the period							The average annual losses
	1971	1972	1973	1974	1975	1976	1977	
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
RAILWAYS	-	4.99 (5.389)	-	-	41.508 (35.586)	-	N.A.	7.749 (6.829)
NATIONAL HIGHWAYS								
(i) N.H.No.5	N.A.	N.A.	0.05 (0.05)	-	6.494 (5.567)	0.228 (0.181)	1.05 (0.771)	1.564 (1.314)
(ii) N.H. No.23	N.A.	N.A.	-	-	0.51 (0.437)	0.515 (0.409)	1.282 (0.943)	0.461 (0.358)
POSTS AND TELEGRAPHS								
(i) Post Offices Cuttack & Dhenkanal Division.	-	-	-	-	0.067 (0.057)	-	-	0.009 (0.008)
(ii) Telegraphs (a) Cuttack Sub-Divn.	N.A.	N.A.	N.A.	0.174 (0.161)	0.369 (0.316)	0.216 (0.171)	NA	0.253 (0.216)
(b) Keonjhar sub-divn.	N.A.	N.A.	N.A.	0.202 (0.187)	0.435 (0.373)	0.251 (0.199)	NA	0.296 (0.253)

Average losses to Central Govt. organizations: 10.33 (8.897)

Source:
1) The data for losses to railways are collected from the SDE, SER, Khurda Road, Orissa.
2) The loss figures for NH are collected from the Chief Engineer (NH), Orissa, Bhubneswar.
3) The loss figures for Post Offices are collected from the SPOs, Cuttack & Dhenkanal.
4) The damages to telephone lines are collected from the SDO Telegraphs, Cuttack and Keonjhar.

Note: The figures within brackets are the loss figures at the base year price level.

ANNEX V(C)
Table 27

CONSOLIDATED STATEMENT OF THE AVERAGE FLOOD LOSSES & THE RELIEF AND GRANTS PROVIDED, DHENKANAL DISTRICT

(Figures in lakh Rs.)

Sl. No.	Name of the block	Av.losses & relief and grants provided due to floods from the Brahmani System	Average losses from all rivers: To private houses	To live-stocks	To roads, bldgs. embankments, etc.	Net crop losses	Total	Av.relief and grants provided during floods (from all rivers)
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
1.	Kaniha	2.375 (2.131)	0.212 (7.06)	0.015 (0.5)	0.162 (5.4)	2.617 (87.04)	3.006 (100)	0.103 (3.43)
2.	Talcher	1.441 (1.277)	0.123 (6.8)	0.001 (0.01)	0.162 (8.99)	1.522 (84.2)	1.808 (100)	0.081 (4.47)
3.	Parajang	1.35 (1.302)	0.136 (10.68)	0.004 (0.34)	0.191 (15.01)	0.943 (73.97)	1.274 (100)	0.114 (8.99)
4.	Odapada	5.355 (4.90)	0.242 (4.39)	0.093 (1.71)	0.322 (5.86)	4.844 (88.04)	5.501 (100)	0.104 (1.9)
5.	Dhenkanal Sadar	2.322 (2.139)	0.242 (10.34)	0.029 (1.27)	0.686 (29.31)	1.384 (59.08)	2.341 (100)	0.120 (5.13)
6.	Kamakhya nagar	1.858 (1.812)	0.727 (20.22)	0.009 (0.27)	0.216 (6.01)	2.645 (73.5)	3.597 (100)	0.149 (4.41)
7.	Bhuban	2.01 (1.816)	0.365 (9.41)	0.006 (0.17)	0.198 (5.11)	3.314 (85.31)	3.883 (100)	0.168 (4.33)
8.	Gondia	4.543 (4.255)	0.618 (11.77)	0.413 (7.86)	0.321 (6.12)	3.90 (74.25)	5.252 (100)	0.133 (2.54)
	Total	4.998 (4.369)	2.667 (10.0)	0.572 (2.14)	2.261 (8.48)	21.170 (79.38)	26.670 (100)	0.973 (3.65)

Note: i) These figures are compiled from Annex V/Tables 1 to 8.
ii) The figures within bracket in column (3) are the figures at base year prices.
iii) The figures within brackets in columns (4) to (9) are the percentages of the respective item to total flood losses from all river systems.

ANNEX V(C)
Table 28

CONSOLIDATED STATEMENT OF THE AVERAGE FLOOD LOSSES & THE RELIEF AND GRANTS PROVIDED, CUTTACK DISTRICT

(Figures in lakh Rs.)

(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
1.	Sukinda	2.044 (1.957)	0.24 (11.83)	0.007 (0.37)	0.32 (15.76)	1.463 (72.04)	2.031 (100)	0.055 (2.70)
2.	Danagadi	4.134 (3.786)	0.382 (9.20)	0.006 (0.16)	0.624 (14.83)	3.189 (75.81)	4.205 (100)	0.084 (2.01)
3.	Korei	5.74 (4.894)	0.986 (9.92)	0.012 (0.12)	0.519 (5.24)	8.426 (84.72)	9.944 (100)	0.207 (2.10)
4.	Rasulpur	23.324 (22.088)	5.307 (23.14)	0.073 (0.31)	1.954 (8.52)	15.592 (68.03)	22.928 (100)	0.395 (1.72)
5.	Dharma-sala	17.87 (16.747)	2.512 (13.18)	0.017 (0.09)	1.695 (8.90)	14.835 (77.83)	19.059 (100)	0.346 (1.80)
6.	Badachana	19.707 (18.151)	3.168 (13.60)	0.009 (0.03)	1.344 (5.80)	18.76 (80.57)	23.282 (100)	0.302 (1.30)
7.	Jajpur	19.812 (18.478)	4.40 (17.4)	0.016 (0.07)	1.656 (6.51)	19.235 (76.02)	25.314 (100)	0.354 (1.40)
8.	Bari	27.901 (27.560)	6.822 (21.83)	0.014 (0.05)	2.403 (7.69)	22.005 (70.43)	31.244 (100)	0.462 (1.48)
9.	Binjhar-pur	14.967 (15.358)	0.935 (6.34)	0.006 (0.05)	0.967 (6.55)	12.850 (87.06)	14.76 (100)	0.206 (1.40)
10.	Dasarath-pur	3.862 (3.293)	0.337 (2.10)	-	1.947 (12.30)	13.579 (85.60)	15.866 (100)	0.283 (1.80)

(contd....)

ANNEX V(C)
Table 28 (contd.)

(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
11.Kendra-pada		1.075 (1.103)	0.649 (8.82)	0.002 (0.02)	0.659 (8.94)	6.06 (82.22)	7.37 (100)	0.024 (0.32)
12.Derabisi		0.907 (0.849)	0.027 (0.43)	-	0.358 (5.73)	5.88 (93.84)	6.266 (100)	0.009 (0.15)
13.Patta-mundai		36.48 (31.216)	9.258 (21.40)	0.046 (0.10)	3.187 (7.36)	30.758 (71.14)	43.261 (100)	0.505 (1.16)
14.Aul		33.612 (34.112)	6.049 (18.16)	0.015 (0.04)	2.216 (6.38)	25.125 (75.42)	30.303 (100)	0.309 (0.92)
15.Raj-kanika		20.076 (20.364)	4.845 (20.18)	-	2.852 (11.87)	16.317 (67.95)	24.016 (100)	0.387 (1.61)
16.Rajnagar		6.147 (6.080)	0.318 (5.52)	0.001 (0.02)	2.169 (20.28)	4.275 (74.18)	5.764 (100)	0.383 (6.65)
	Total	237.664 (226.044)	46.24 (16.02)	0.228 (0.07)	23.786 (8.25)	218.355 (75.66)	288.618 (100)	4.317 (1.50)

Note: i) The figures are compiled from Annex V/Tables 9 to 24.

ii) The figures within brackets in column (3) are the figures at base year prices.

iii) The figures within brackets in columns (4) to (9) are the percentages of the respective item to total flood losses from all river systems.

ANNEX V(D)
Table 29

THE AREA AFFECTED BY FLOODS AS WELL AS THE AREA UNDER CULTIVATION IN THE CONTROL VILLAGES

(Figures in acres)

Sl No.	Name of the village	Name of the block	Area affected by floods 1955	1960	1970	1977	Area under cultivation 1955	1960	1970	1977
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)
In Lower Flood-plain										
1.	Ghantal	Nischintkoili	500	Nil	Nil	Nil	300	400	450	500
2.	Harirajpur	"	1000	Nil	Nil	Nil	800	900	900	1000
3.	Bandhakatia	"	600	Nil	Nil	Nil	400	500	600	600
4.	Angyapur	"	500	Nil	Nil	Nil	400	500	500	500
5.	Bisampada	"	2000	Nil	Nil	Nil	800	1200	1500	2000
6.	Sirilo	Raghunathpur	450	Nil	Nil	Nil	250	300	350	450
7.	Brahman khanda	"	750	250	100	100	800	850	900	1000
8.	Babujanga	"	500	50	50	50	300	400	500	550
In Lower most Flood-plain (adjacent to the littoral tract)										
9.	Gobardhanpur	Kujang	400	Nil	Nil	Nil	250	300	350	400
10.	Bibachhpur	"	350	Nil	Nil	Nil	100	200	350	350
	Total		7050	300	150	150	4400	5550	6300	7350
	Percentage		100	4.25	2.13	2.13	100	126.1	143.2	167.1
In Middle Flood-plain										
11.	Berhampur	Athagarh	500	Nil	Nil	Nil	500	600	650	800
12.	Kanderpur	"	500	200	100	50	250	350	400	600
13.	Megha	"	400	Nil	Nil	Nil	350	500	600	650
14.	Chakragarh	Narsinghpur	250	Nil	Nil	Nil	200	250	300	350
15.	Subalaya	"	150	Nil	Nil	Nil	150	200	250	300
16.	Brahmapura	"	250	Nil	Nil	Nil	100	200	250	325
17.	Ukdal	"	350	Nil	Nil	Nil	350	400	450	550
	Total		2400	200	100	50	1900	2500	2900	3575
	Percentage		100	8.33	4.16	2.08	100	131.1	152.1	188.5

Note: These are the primary survey data, collected from the sample villages during our field visits.

ANNEX V(D)
Table 30

NUMBER OF CROPS GROWN IN THE CONTROL VILLAGE AREAS

Sl. No.	Name of the village	Name of the block	Number of crops grown 1955	1960	1970*	1977*
(1)	(2)	(3)	(4)	(5)	(6)	(7)
In the Lower Flood-plain (adjacent to the delta)						
1.	Ghantal	Nischintkoili	2	3	3	3-4
2.	Harirajpur	"	2	3	3	3-4
3.	Bandhakatia	"	2	3	3-4	3-4
4.	Angyapur	"	2	3	3	3
5.	Bisampada	"	1	2	2	2
6.	Sirilo	Raghunathpur	1-2	2	3	3-4
7.	Brahmankhanda	"	1-2	2	3	3-4
8.	Babujanga	"	1	2	3	3
In the Lower most Flood-plain (adjacent to the littoral tract)						
9.	Gobardhanpur	Kujanga	1	2	3	3-4
10.	Bibachhapur	"	1	2	3	3-4
In the Middle Flood-plain (adjacent to the middle valley)						
11.	Berhampur	Athagarh	2	2	3	3-4
12.	Kandarpur	"	1-2	2	2	3-4
13.	Megha	"	1-2	2	2	3
14.	Chakragarh	Narasinghpur	1-2	2	2	2-3
15.	Subalaya	"	1-2	2	2	2-3
16.	Berhampura	"	1	1	2	2
17.	Ekdal	"	1-2	2	2	2-3

Note: Results of our primary survey data, collected from the sample villages during our field visits.

* It was observed that most of these sample villages had availed lift irrigation facilities in the seventies.

ANNEX V(D)
Table 31

THE CROPPING PATTERNS, YIELD RATES & NET INCOME GENERATED PER ACRE IN THE CONTROL BLOCKS

Name of the block	Seasons	Crops grown	In 1955 Yield rate per Acr. (in Qtl)	In 1955 Net income generated (in Rs)	1960 onwards Yield rate per Acr. (Qtls)	1960 onwards Net income generated (Rs)	1970 onwards Yield rate per Acr. (Qtl)	1970 onwards Net income generated (Rs)	In 1977 Yield rate per Acr. (Qtl)	In 1977 Net income generated (Rs)
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)
Nischintkoili	Kharif	Jute	Nil	Nil	5	300	6	500	9	800
		L.Paddy	5	100	7	300	8	500	8	900
		HYV "	Nil	Nil	Nil	Nil	15	700	16	1300
	Rabi	Pulses	4	150	4	200	5	300	5½	600
		G.Nut	Nil	Nil	3	200	5	500	6	800
	Summer	Veg.	Nil	Nil	Nil	Nil	40	900	50	1500
Raghunath pur	Kharif	Paddy	4	100	8	400	10	600	10	900
		HYV "	Nil	Nil	Nil	Nil	Nil	Nil	15	1200
	Rabi	Pulses	Nil	Nil	4	200	4	300	4	600
		G.Nut	2	100	3	300	4	500	5	700
		Wheat	Nil	Nil	Nil	Nil	Nil	Nil	8	600
	Summer	Veg.	Nil	Nil	Nil	Nil	30	1000	40	1500
Kajunga	Kharif	L.Paddy	2	0-100	3	300	5	500	8	800
		HYV "	Nil	Nil	Nil	Nil	Nil	Nil	12	1200
	Rabi	Pulse	Nil	Nil	2	100	3	200	4	600
		G.Nut	Nil	Nil	2	100	4	250	4	700
	Summer	Veg.	Nil	Nil	Nil	Nil	30	1000	40	1500
Athagarh	Kharif	L.Paddy	2	0- 50	4	200	6	350	8	700
		HYV "	Nil	Nil	Nil	Nil	Nil	Nil	15	1000
	Rabi	Pulses	4	100	4	250	4	400	4½	600
		G.Nut	Nil	Nil	Nil	Nil	5	500	6	800
		Veg.	Nil	Nil	Nil	Nil	25	850	50	2000
	Summer	Veg.	Nil	Nil	Nil	Nil	25	1000	30	1500
Narasingpur	Kharif	L.Paddy	2	0 -50	3	150	5	300	8	700
		HYV "	Nil	Nil	Nil	Nil	Nil	Nil	12	1000
	Rabi	Pulse	4	100	4	250	4	400	4	550
		G.Nut	Nil	Nil	Nil	Nil	5	500	6	800
		Wheat	Nil	Nil	Nil	Nil	Nil	Nil	5	300
	Summer	Veg.	Nil	Nil	Nil	Nil	Nil	Nil	25	1000

Note: Our primary survey results. Most of these data are best approximations, collected from the villagers during our field visits.

ANNEX V(D)
Table 32

AVERAGE NET INCOME GENERATED PER ACRE PER ANNUM IN THE CONTROL BLOCKS

(Figures in Rs.)

Name of the Block	Net Income Generated							
	In 1955		1960 onwards		1970 onwards		In 1977	
	Non irri.	Irri.	Non irri.	Irri.	Non irri.	Irri.	Non irri.	Irri.
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
Narasingpur	100 (400)	-	400 (740)	-	700 (882)	1400 (1764)	1300 (956)	2500 (1838)
Athagarh	100 (400)	-	450 (833)	-	850 (1071)	1700 (2142)	1500 (1103)	3100 (2279)
Raghunathpur	200 (800)	-	600 (1110)	-	950 (1196)	1900 (2393)	1650 (1213)	3300 (2426)
Nischint-koili	250 (1000)	-	800 (1480)	-	1300 (1638)	2400 (3023)	2300 (1691)	4200 (3087)
Kujanga	100 (400)	-	400 (740)	-	700 (882)	1700 (2142)	1400 (1029)	3100 (2279)

Note: Figures within brackets are the net value figures at the base year price levels.

ANNEX V(E)
Table 33

ASSUMPTIONS WITH RESPECT TO RECLAMATION OF CULTIVABLE LANDS IN THE BRAHMANI FLOOD-PLAIN

Name of the flood plain	% of the total area expected to be reclaimed	% of the sand casted area to be reclaimed.				% of the water-logged area to be reclaimed			
		0-5 Yrs.	6-15 Yrs.	16-25 Yrs.	Total	0-5 Yrs.	6-15 Yrs.	16-25 Yrs.	Total
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
(a) Upper portion of the middle flood-plain.	75	10	25	25	60	5	5	5	15
(b) Lower portion of the middle Flood-plain.	75	10	20	20	50	5	10	10	25
(c) Upper portion of the lower flood-plain.	60	5	12.5	12.5	30	5	12.5	12.5	30
(d) Middle portion of the lower flood-plain.	60	5	7.5	7.5	20	5	17.5	17.5	40
(e) Lower most Flood-plain.	60	5	5	5	15	5	20	20	45

Note: These assumptions are based on our observations in the control areas of the Mahanadi flood-plain as well as on the basis of our discussions with the field officials during our field trips in the Brahmani flood-plain.

ANNEX 5(E)
Table 34

CULTIVABLE AREA RECLAIMABLE IN THE BRAHMANI FLOOD-PLAIN AFTER COMPLETION OF THE RMP

(Figures in acres)

Name of the Block	Present cultivated area affected	Area expected to be reclaimed	Sand-casted area reclaimable			Water-logged area reclaimable		
			Yrs. 0-5	6-15	16-25	0-5	6-15	16-25
Middle Flood-plain (upper portion)								
1)Kaniha	2289	1716	229	573	572	114	114	114
2)Talcher*	1491	1119	149	373	373	75	74	75
3)Parajang	2825	2122	283	706	706	143	142	143
4)Odapada	7491	5618	749	1873	1873	374	375	375
Middle Flood-plain (lower portion)								
5)Dhenkanal	2727	2045	273	545	545	136	273	273
6)K.Nagar	3382	2536	338	676	677	169	338	338
7)Bhuban*	7195	5395	719	1439	1439	360	719	719
8)Gondia	8675	6505	867	1735	1735	434	867	867
9)Sukinda	6034	4525	603	1207	1207	302	603	603
10)Danagadi*	5700	4275	570	1140	1140	285	570	570
Lower Flood-plain (upper portion)								
11)Korei	7384	4430	369	923	923	369	923	923
12)Rasulapur	26145	15686	1307	3268	3268	1307	3268	3268
13)Dharmasala	26588	15954	1329	3324	3324	1329	3324	3324
14)Badachana	16189	9714	809	2024	2024	809	2024	2024
Lower Flood-plain (middle portion)								
15)Jajpur	26062	15638	1303	1955	1955	1303	4561	4561
16)Bari	34938	20962	1747	2620	2620	1747	6114	6114
17)Binjharpur	25000	15000	1250	1875	1875	1250	4375	4375
18)Dasarathpr	5408	3244	270	406	406	270	946	946
19)Kendrapada	916	550	46	69	69	46	160	160
20)Derabisi	1188	712	59	89	89	59	208	208
21)Pattamundai	40134	24080	2007	3010	3010	2007	7023	7023
Lower most Flood-plain								
22) Aul	41407	24842	2070	2070	2070	2070	8281	8281
23)Rajkanika	8899	5340	445	445	445	445	1780	1780
24)Rajnagar	27042	16224	1352	1352	1352	1352	5408	5408
Total	335109	208232	19143	33697	33697	16755	52470	52470

Note: The figures are compiled on the basis of our assumption in Table 33.
* The data for these blocks are inclusive of Talcher Municipality and the Bhuban and Jajpur road NACs respectively.

ANNEX V(E)
Table 35

PROJECTION OF INDIRECT BENEFITS WITH RESPECT OF THE RECLAIMABLE CULTIVABLE LANDS IN THE BRAHMANI FLOOD-PLAIN

(Income figures at base year prices)

Years	Area recl-aimable (in acres)	Cumulative area re-claimable (in acres)		Addl. net income per acre (in Rs)	Total net gains (in lakh Rs)
(1)	(2)	(3)		(4)	(5)
Upper portion of the Middle Flood-Plain:					
1983 - 88	2115	2115	2115**	340	7.19
1988 - 98	4230	6345	6345**	482	30.58
1998 -2008	4230	10575	2644*	1438	38.02
			7931**	556	44.10
Lower Portion of the Middle Flood-plain:					
1983 - 88	5056	5056	5056**	433	21.89
1988 - 98	10112	15168	15168**	671	101.78
1998 -2008	10113	25281	7584*	1879	142.50
			17697**	803	142.11
Upper portion of the Lower Flood-plain:					
1983 - 88	7628	7628	7628**	310	23.65
1988 - 98	19078	26706	4006*	1593	63.82
			22700**	396	89.89
1998 -2008	19078	45784	20603*	1626	335.00
			25181**	413	104.00
Middle Portion of the Lower Flood-plain:					
1983 - 88	13364	13364	13364**	480	64.15
1988 - 98	33411	46755	7016*	2023	141.94
			39759**	638	253.66
1998 -2008	33411	80186	36084*	2087	753.07
			44102**	691	304.75
Lower most Flood-plain:					
1983 - 88	7734	7734	7734**	340	26.30
1988 - 98	19336	27070	2707*	1742	47.16
			24363**	482	117.43
1998 -2008	19336	46406	13922*	1879	261.60
			32484**	629	204.32

Note: i) Figures in columns 2 & 3 have been derived from Annex V(E)/Table 34.
ii) Figures in column 4 have been derived from Annex V(D)/Table 32.

* Area Irrigated.
** Area Non-irrigated.

ANNEX V(E)
Table 36

PROJECTION OF INDIRECT BENEFITS WITH RESPECT TO PRESENT CULTIVATED LANDS IN THE BRAHMANI FLOOD-PLAIN

Years	Cultivated area (in acres)		Addl.net income per acr. at base year prices (in Rs)	Total net gains at base year prices (in lakh Rs)
(1)	(2)		(3)	(4)
Upper portion of the Middle Flood-plain:				
1983 - 88	10096	1009*	1024	10.33
		9087**	142	12.91
1988 - 98	10096	2524*	1098	27.71
		7572**	216	16.36
Lower portion of the Middle Flood-plain:				
1983 - 88	33713	3371*	1309	44.13
		30342**	238	72.21
1988 - 98	33713	8428*	1446	121.87
		25285**	270	68.27
Upper portion of the Lower Flood-plain:				
1983 - 88	76306	7630*	1283	97.89
		68676**	86	59.06
1988 - 98	76306	19071*	1316	251.04
		57230**	103	58.95
Middle portion of the Lower-Flood-plain:				
1983 - 88	133646	13364*	1543	206.21
		120282**	158	190.04
1988 - 98	133646	40094*	1607	644.31
		93552**	211	197.40
Lower most portion of the Flood-plain:				
1983 - 88	77348	7735*	1402	108.44
		69613**	142	98.85
1988 - 98	77348	19337*	1539	297.60
		58011**	289	167.65

Note: The projection is based on the following assumptions:

i) That there would be full development within 15 years of the completion of the project; hence, the addl. net income figures have been computed with the sixties standard of the control project as the base.

ii) The development of irrigation within 15 years would be 25% for the upper and lower portion of the middle flood-plain, upper portion of the lower flood-plain and the lower most flood-plain, and 30% of the middle portion of the lower flood-plain.

* Area Irrigated, and ** Area Non-irrigated.

ANNEX V(E)
Table 37

THE INDIRECT PRIMARY BENEFITS WITH RESPECT TO AGRICULTURAL DEVELOPMENT IN THE BRAHMANI FLOOD-PLAIN

(Figures in lakh Rs. at base year prices)

Years	Benefits from the area presently cultivated in the flood-plain (expected benefits from changes in cropping patterns)					Benefits from the area expected to be reclaimed in future					Total benefits
	in UPMFP	in LPMFP	in UPLFP	in MPLFP	in LMFP	in UPMFP	in LPMFP	in UPLFP	in MPLFP	in LMFP	
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
1983-88	23.24	116.34	156.95	396.25	207.29	7.19	21.89	23.65	64.15	26.30	1043.25
1988-98	44.07	190.14	309.99	841.71	465.25	30.58	101.78	153.71	395.60	164.59	2697.42
1998-2008	44.07	190.14	309.99	841.71	465.25	82.12	284.61	439.00	1057.82	465.92	4180.63
2008 - onwards	44.07	190.14	309.99	841.71	465.25	82.12	284.61	439.00	1057.82	465.92	4180.63

Note: i) These figures are compiled from Tables 35 and 36/ Annex V(E).

ii) The abbreviations are:
a) UPMFP - Upper portion of the middle flood-plain.
b) LPMFP - Lower portion of the middle flood-plain.
c) UPLFP - Upper portion of the lower flood-plain.
d) MPLFP - Middle portion of the lower flood-plain.
e) LMFP - Lower most flood-plain.

ANNEX V(F)
Table 38

RENGALI DAM PROJECT: NET FIRM ENERGY AVAILABLE & THEIR ALLOCATIONS BETWEEN DIFFERENT SECTORS

(Figures in lakh KWH.)

Sl. No.	Particulars	1983-85	1985-88	1988-89	1989 onwards
(1)	(2)	(3)	(4)	(5)	(6)
A)	Net firm energy available	5230.00	5230.00	6320.00	6320.00
B)	Allocation of the firm energy between different sectors:				
i)	Domestic light & small power	118.72 (2.27)	134.93 (2.38)	189.60 (3.00)	189.60
ii)	Commercial light & small power	7.49 (1.52)	87.86 (1.68)	101.12 (1.60)	101.12
iii)	Public lighting	15.69 (0.30)	16.21 (0.31)	18.96 (0.30)	18.96
iv)	Public water works and sewerage pumping	29.81 (0.57)	30.33 (0.58)	37.92 (0.60)	37.92
v)	Irrigation & dewatering	33.47 (0.64)	37.66 (0.72)	50.56 (0.80)	50.56
vi)	Industries: a) LT	137.02 (2.62)	154.81 (2.96)	189.60 (3.00)	189.60
	b) HT (less than 1 MW)	343.61 (6.57)	370.81 (7.09)	442.40 (7.00)	442.40
	c) HT (1 MW & above)	4345.60 (83.09)	4273.43 (81.71)	5131.84 (81.27)	5131.84
vii)	Railway/Trainway track.	100.41 (1.92)	98.85 (1.89)	126.40 (2.00)	126.40
viii)	Bulk supply to non-indl.consumers	24.05 (0.46)	25.11 (0.48)	31.60 (0.50)	31.60

Note: i) Figures in row (A) are compiled from the project report.
ii) Figures within brackets are the percentages of consumption by each sector.
iii) The other figures are our own estimates compiled on the basis of the projected consumption patterns. While the percentages of consumption in columns (3) and (4) are taken from the projected estimates of the OSEB for the respective years, the percentages in column (5) are our assumptions, which are based on the past trends.

ANNEX V(F)
Table 39

GROSS ANNUAL BENEFITS FROM THE NET FIRM ENERGY OF RMP, ORISSA

Sl. No.	Particulars	Net firm energy allocated to each consuming sector per year (in lakh KWH) 1983-85	1985-88	1988 - onwards	Tariff rates per unit (in paisa)	Money value of energy (in lakh Rs.) 1983-85	1985-88	1988 - onwards
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
A)	The consuming sectors:							
i)	Domestic light & small power	118.72	134.93	189.60	31	36.80	41.83	58.78
ii)	Commercial " " "	79.49	87.86	101.12	34	27.20	29.87	34.38
iii)	Public lighting	15.69	16.21	18.96	26	4.07	4.21	4.93
iv)	Public water works & sewerage pumping	29.81	30.33	37.92	11	3.27	3.34	4.17
v)	Irrigation & Dewatering	33.47	37.66	50.56	16	5.35	6.03	8.09
vi)	Industries:							
	a) LT	137.02	154.81	189.60	18	24.66	27.87	34.13
	b) HT (less than 1 MW)	343.61	370.81	442.40	18	61.84	66.75	79.63
	c) HT (1 MW & above)	4345.60	4273.43	5131.84	12	521.47	512.81	615.82
vii)	Railway/Traction supply	100.41	98.85	126.40	12	12.04	11.86	15.17
viii)	Bulk supply to non-industrial consumers	24.05	25.11	31.60	15	3.60	3.77	4.74
	Total	5230.00	5230.00	6320.00	-			
B)	Gross value added by total power generation (in lakh Rs.)					700.12	708.34	859.84
C)	Gross value added with 60% addl. weight (in lakh Rs.)					1166.85	1180.57	1433.07

Note: The tariff rates are taken from "The Orissa Gazettee (extra-ordinary)", Nov.30, 1974. OSEB, Bhubaneswar.

ANNEX V(G)
Table 40

RENGALI DAM PROJECT:

ESTIMATION OF INDIRECT PRIMARY BENEFITS FROM COMMUNICATION, TRANSPORTATION AND MARKETING DEVELOPMENT

(Figures in lakh Rs.except columns 7,8 and 10)

Sl. No.	Time period	Investment on project facilities: communication.	Investment on project facilities: Bldg.	Cumulative of (3) and (4)	Ind. Inv.benefits from(5)	No.of Buses plying to Rengali Dam site: all weather.	No.of Buses plying to Rengali Dam site: Fair weather.	Ind. benefits of these transport services	No.of shops hotels, etc.at RMP site	Ind; benefits from Mkt. services	Total in direct benefits of the RMP (6+9+11)
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
1.	1972-73	1.46	1.07	2.53	-	-	-	-	-	-	-
2.	1973-74	36.73	11.79	51.05	7.66	2	-	0.60	10	0.30	8.56
3.	1974-75	22.67	56.19	129.91	19.49	4	-	1.20	50	1.50	22.19
4.	1975-76	13.11	31.02	174.04	26.11	5	-	1.50	100	3.00	30.61
5.	1976-77	29.49	44.47	248.00	37.20	5	1	1.65	150	4.50	43.35
6.	1977-78	16.54	55.46	320.00	48.00	7	4	2.70	200	6.00	56.70
7.	1978-79	-	-	320.00	48.00	7	4	2.70	200	6.00	56.70
8.	1979-80 to 82-83	-	-	320.00	48.00	7	4	2.70	200	6.00	56.70
9.	83-84 to 87-88		-	320.00	48.00	5	1	1.65	100	3.00	52.65
10.	88-89 -onwards		-	320.00	48.00	5	1	1.65	100	3.00	52.65

Note:
1) Figures in columns (3) & (4) have been collected from the office of the FA & CAO, Rengali Multi-purpose Project, Rengali, Orissa.
2) Figures in column (6) have been calculated by us on the basis of 15% perpetual return on these investment.
3) Figures in columns (7),(8) & (10) are our primary survey results.

CALCULATION OF FLOOD CONTROL BENEFITS BY THE PROJECT AUTHORITIES

THE OFFICIAL METHODS:

The project authorities had calculated the flood control benefits of the RMP with the help of the official methods, i.e., on the basis of the guidelines provided by the CW & PC. With respect to the estimation of flood control benefits, the CW & PC had often recommended to take into consideration the direct benefits only, viz., the avoidance of flood damages as well as the relief provided to the people of the flood aflicted areas. The Central Board of Irrigation and Power had directed to omit the indirect and secondary benefits from the calculations on the ground that the method of calculation was expensive and cumbersome, and also sometimes it provided obvious opportunities for the concerned state Governments, who generally fight among themselves for centrally sponsored projects, to manipulate the benefits to show greater justification. Adhering to these norms of the CW & PC, the project authorities of the Rengali Dam project had calculated the flood control benefits of the project. However, we have come across the following two sets of calculation of the flood control benefits in the project reports:

(1) Correlation between Discharge & Damage Method, and

(2) Damage Apportionment Method.

(1) DISCHARGE & DAMAGE METHOD:

In the July 1972 project report the method of calculation of flood control benefits was one of "correlation between discharge and damage method". This was a theoretical approach based on the maximum discharge data of the river at the head of the delta, Jenapur.

In this method the average flood damages proposed to be prevented and the subsequent relief expenses saved were taken together as the flood control benefit of the project. And in order to arrive at the flood damage figures they had regressed the maximum discharge of the river upon the

damage by an arbitrary mathematical formulae. The discharge data used for the same were the maximum gauge readings at Jenapur from the year 1881 to 1971. After estimating the flood damages by the above method, they had assumed that the relief provided due to floods would be 50% of the flood damages. Then by adding the flood damage figure and the relief, they had calculated the total damage figures in a particular year. Finally the average flood control benefit figure was calculated by a simple arithmatic mean method and the same was calculated at Rs.145.54 lakhs per annum.[1]

With regard to this method of calculation of flood control benefits we have observed that this classical method suffers from a number of drawbacks. The drawbacks are:

(i) Biased towards Discharge:

There is no doubt that there exists a correlation between flood damage and discharge of water in the river. But discharge of water is not the only factor. There are some other factors which are also crucial for determination of the magnitude of flood damages. The other important variables that contribute to the flood damages are: the number of breaches in the embankments, period of flooding, number of days of inundation, rainfall in the catchment and the deltaic region, tidal waves or variations in the sea level, flood fighting measures undertaken (before, during and after floods), silting of river bed, land slides, backwater effects, and the littoral sand drifts.

As the above method has neglected the influences of the other important variables, it appears that this method is biased towards discharge.

(ii) Arbitrary Calculations of Relief:

Secondly, the estimation of the monetary valuations of relief undertaken to fight the flood hazards is not based

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1. For detailed calculations see, Appendix No.RI (Section I, Clause 5.3), Project Report, Vol.I Part B, General Report, Rengali Dam Project, Irrigation & Power Dept. Govt. of Orissa, 1972.

on any scientific method or rational norm. We do not find any justification for assuming 50% of the flood damages as relief provided to the people in the flood affected areas. From our discussions with the revenue authorities of the state as well as with the Deputy Secretary (Special Relief), Board of Revenue, Orissa, Cuttack we have not found any evidence that relief constitute 50% of the flood damages. They were of the opinion that the relief might be roughly 2 to 3 percent of the damages. Further, the block-wise flood losses data, collected by us from the revenue authorities, have shown that the average grant and relief figure was 1.50 and 3.65 percent of the total flood damages for Cuttack and Dhenkanal district respectively.[2] Furthermore, the assumption of 50% has itself contradicted the subsequent assumption of the project authorities because in the supplementary project report the same was assumed to be 20% of the flood damages.

(iii) Neglect of the Inflationary Trend:

As we know, owing to the inflationary trend, the money values of goods and services in different years are not the same. The changes in the price level bring about changes in the value of goods and services. To overcome this sort of difficulty, the economists have prescribed to adopt a method of deflation or inflation of benefits and costs for different time periods.

In the present method of calculation of flood control benefits, the money values of damages in various years are not being deflated or inflated by any standard factor. Hence, the additions of the total damage figures over a range of 90 years time period to arrive at the mean average damage figure does not seem to be justifiable.

(iv) Based on Weak Data Base:

The figures on discharge of water in the river were taken at the head of the delta, Jenapur. On cross-examining the data base from various sources, we have observed that

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2. For our detailed calculations, see, Annex 5(c)/ Table 27 and 28.

sometimes the discharge figures given in the project report do not tally with the figures recorded by the Flood Investigation Division, Orissa, Cuttack, which is mainly responsible for collection of these records. The existence of discrepancy of higher discharge figures in the project report had provided an opportunity to the project authorities to push up the damage figures.

Again the records of the gauge reading station at Jenapur are misleading for few years. A mere glance at the data collected from the Flood Investigation Division puzzles one very much because for the years 1965 to 1970, the maximum discharge recorded at Jenapur were less than the guage reading figures at an upstream point Talcher,. Here we would like to add that between Talcher and Jenapur, below which the river branches off only, there are some important tributaries, namely the Nigra, Nandira, Ramial and the Damsal and other hill streams and nullahs, joining the main stream of the Brahmani. Thus, it is usually expected that the water discharged at Jenapur must be higher than the water discharged at Talcher. Of course, there may be deviations under extra-ordinary circumstances like breaches in the embankments between Talcher and Jenapur when the water of the main river may rush into the vicinity and thereby reduce the discharge at Jenapur. But no such breaches were being reported for these periods. Thus we can say that the data base used for calculation of flood control benefit is very weak.

(v) Contradictions with The Past Studies:

The calculation of total damages do not confirm to the estimates made by Mr. J. Shaw, the Executive Engineer of Flood & Drainage Division, Cuttack in the year 1938. The present estimates are on a much higher side.

Mr. J. Shaw made the evaluation of flood damages for the state of Orissa for 29 years - from 1910 to 1938. His calculations and comparative years calculations by the present method are given below for comparison purposes.

J. SHAW'S CALCULATION[3]		PROJECT AUTHORITIES CALCULATION[4]	
Year	Damages for the State of Orissa by all river systems	Year	Damages by the Brahmani only
1911	Rs. 30 lakhs	1907	Rs. 600 lakhs
1919	Rs. 68 lakhs	1916	Rs. 615 lakhs
1920	Rs. 29 lakhs		
1925	Rs. 25 lakhs		
1926	Rs. 60 lakhs	1926	Rs. 372 lakhs
1927	Rs. 35 lakhs		
1929	Rs. 29 lakhs	1929	Rs. 570 lakhs
1933			
a) House damages	Rs.1,45,000		
b) Crop damages	Rs.53,95,000		
c) PWD "	Rs. 56,000		
d) Roads etc.	Rs. 37,000		
	Rs. 56 lakhs		
1937			
a) House damages	Rs. 29,000	1943	Rs. 540 lakhs
b) Crop damages	Rs.28,62,600		
c) PWD "	Rs. 59,000		
d) Roads, etc.	Rs. 13,000		
	Rs. 29.5 lakhs		
1955	Rs.1,211 lakhs	1955	Rs. 566 lakhs
		1959	Rs. 127 lakhs

The comparison between the two estimations of damages reveals that the present method of calculation has put the damages at unrealistic high figures. When the damages for the state of Orissa in the year 1926 was

3. Source: Floods in Orissa Rivers (Final Report), 1955-56, Government of Orissa, Revenue (Special Relief), Orissa.

4. Source: Rengali Dam Project, Vol.1, Part B, General Report.

Rs. 60 lakhs (J.Shaw's calculation), the project authorities have put the figure for the Brahmani only at Rs.372 lakhs. This clearly shows how unrealistic are the present calculations?

(vi) <u>Neglects the Apportionment of Damages</u>:

It is already explained in chapter II that there is a net-work of river systems in the deltaic region of Orissa. In certain blocks the damages occur simultaneously due to floods in more than one river system. In that case there is the necessity of apportionment of flood damages between different river systems.

This method of "discharge & damage" has failed to take into consideration the method of apportionment of flood damages because the damages are calculated on the basis of the discharge of waters in the river at the head of the delta, below which only the branches of other rivers have joined the Brahmani and simultaneously caused extensive damages in the adjacent areas.

(2) DAMAGE APPORTIONMENT METHOD:

This second set of estimation of the flood control benefit of the project was available in the "supplement to Project Report, 1972", which was finally approved by the Planning Commission, GOI. In this methodology, the overall flood damages for the state of Orissa were taken into account from 1959 to 1971 and the average annual damage was calculated by a simple arithmatic mean method. To this average, the Project authorities have added the relief expenditure. (which was assumed to be 20% of the damages) and the annual losses to railways and other central Government undertakings in order to get the final annual damage figures attributable to floods. Since the authorities were interested in calculating the flood control benefit of the Brahmani only, then they have resorted to a method of apportionment of damages between different river systems on the basis of flows based on split data for some years. Following the above principle they have allocated 50% of the total damages to the Brahmani, 35% to the Baitarani, and 15% to the Mahanadi and other river systems. By this above method, the direct flood control benefits to be accruing

to the project would be Rs.686.24 lakhs per annum.[5]

Even though this method of calculation has some advantages over the previous one, no doubt, there are certain drawbacks. The following are the demerits of this method.

(i) Problem of Monetisation of Losses:

The major drawback of this methodology is that no adequate attention is being given to monetise the damages to crops, houses, cattle and public utilities. In the statement sheet we find the figures on: area and population affected, crop damages and its valuation, number of houses damaged and its valuation, number of cattle and human lives lost, and the damages to public utilities for different years. In column 12 of statement No.14, the total damage figures are arrived by adding the losses to crops, houses and public utilities. Even though it is difficult to monetise the loss of human lives, the cattle losses could have been monetised in order to be inserted into the calculation. But it seems no attempt had been made to convert the cattle losses into monetary terms. So also, for some years the damages to crops, houses and public utilities were not being approximated and left out of calculations. Thus, we can say that the calculations were not true representatives of the losses.

(ii) Weak Basis of Assumption of Relief:

The assumption of 20% of damages as relief is open to challenge. Even though it is mentioned in the project report that the assumption is found from standard statistics, the source of the statistics is not being given. Neither the project authorities nor the officials of the central water Commission (Flood Control Directorate) could help us to get this standard statistics. Our subsequent discussions with the revenue authorities in Orissa and also

5. For detailed calculations see, statement No.14, Supplement to Project Report, Rengali Dam Project, I & P Department, Govt. of Orissa, 1975.

the data collected by us for calculation of flood control benefits do not confirm to this assumption of relief estimation.

(iii) Neglect of the Inflationary Trend:

Like the "discharge and damage method", this method has also neglected the impact on inflation in estimating the average loss figures.

(iv) The Assumption of Damages to Central Govt. Undertakings:

In the project report it was assumed that the annual losses to railways and other Govt. of India organizations were about Rs.100 lakhs. But our detailed calculations have shown that the figure used by the project authorities is highly overestimated. The central Govt. undertakings operating within the Brahmani flood-plain are the railways, posts and telegraph department and the National Highways. We have taken the pains to collect detailed data from these organisations and calculations are given in Table 26/ Annex 5(c). The average annual losses to these organisations are worked out as Rs.10.33 lakhs at market prices and Rs.8.89 lakh at the base year (1973) price levels. Thus, the project authorities assumptions are on a much higher side of over estimation.

(v) Problems with the Apportionment of Damages:

The basis of apportionment of damages between different river systems is not convincing to us because the data base is very weak. We have our doubts about the availability of the split data in a scientific way. The apportionment of 50% of damages to the Brahmani and 35% to the Baitarani appears to be inflated and biased towards these two rivers.

(vi) Contradicts the Post Calculations:

The present calculation of average annual flood losses at Rs.1372.48 lakhs for the state of Orissa is on a much higher side than the losses occurring in the recent past. The floods of 1955 was one of the high flood years

for Orissa. While the total flood losses of 1955 were Rs.1,211 lakhs for the state of Orissa then, how can the average annual losses from 1959 to 1971, even after the moderation of floods in the Mahanadi system by the Hirakud Dam, be Rs.1372.48 lakhs? Hence, we have our doubts to this above calculation of flood control benefits by the project authorities.

Owing to the above mentioned weaknesses of the methods of calculations of flood control benefits given in the project reports, we would like to conclude that both the methodologies adopted by the project authorities have no scientific bases nor do they confirm to the empirical calculations of flood damages. Hence, we have rejected both the sets of official calculation of flood control benefits for the purpose of our analysis.

CLASSIFICATION OF FLOOD CONTROL BENEFITS OF THE RMP

- Primary benefits (those occuring in the first round of income and expenditure cycle)
  - Direct primary
    - Reservoir benefits
      - Recreation
      - Fish and wild life
      - Addl. agril. operations in the periphery land
    - Embankment benefits
    - Damage aversion benefits
      - Direct damages to physical property (exa: losses to crops, private houses, live stocks, public institutions and property, communication and transport, forestry and fishing)
      - Indirect damages (i.e. the losses caused due to interruptions of economic activities)
      - Adjustment costs (Exa: flood fighting disaster relief, evacuation and reoccupation expenses and other emergency actions)
  - Indirect primary
    - Addl. agrl. production
    - Extension of drinking water facilities
    - Increased land values
    - Extension of navigation.
    - Growth of ground water potential.
    - Saving of construction costs.
    - Fish & wild life dev.
- Secondary Benefits (those occuring in the second-round of income and expenditure cycles)
  - Direct secondary (those emanate from primary benefits. Exa: growth of sectors like Sugar, Rice haulers, Oil crushers, Fertilizer, Pesticides etc.)
  - Indirect secondary (those flow from direct secondary benefits. Exa: growth of machinary and machine parts, raw material sectors etc

ANNEX VII
Table 1

THE FINANCIAL COSTS OF THE RMP (Flood Control & Drainage)

(Figures in lakh Rs.)

Sl. No.	Item of work	Total Qnty. of work anticipated	Total value anticipated	Amount spent by end of 3/77	Projected Figures 77-78	78-79	79-80	80-81	81-82	82-83
A.	Civil works									
1)	Excavation	460000 Cum	165.6	103.05	62.55	-	-	-	-	-
2)	Masonary dam & power dam:									
	i) Masonary	326619 "	565.05	-	22.14	146.14	186.94	166.76	39.13	3.94
	ii) Concrete	85481 "	495.79	-	69.60	261.00	75.17	33.67	50.56	5.80
3)	Spillway: i) Masn.	200881 "	347.52	30.51	111.85	97.74	18.15	65.30	23.96	-
	ii) Concre.	167519 "	971.61	7.08	255.48	187.73	181.42	157.62	133.17	39.13
	iii) Gates	5505 Sq.M.	623.78	-	50.00	250.00	108.00	60.00	108.00	47.78
4)	Training wall	10600 Cum	18.34	-	-	-	11.46	6.88	-	-
5)	Diversion: i) Chan.	81450 "	27.00	27.00	-	-	-	-	-	-
	ii) Coffer dam	172133 "	82.58	10.00	72.53	-	-	-	-	-
6)	Dykes: i) Excav.	8481 "	2.65	-	-	-	2.65	-	-	-
	ii) Pitch.& turf.	5000 sq.M.	1.55	-	-	-	-	1.55	-	-
7)	Machinery & equip.	-	41.93	95.97	15.00	30.00	-40.00	-30.00	-29.04	-
B.	Land:									
	a) Land acquisition	42500 hect.	1509.44	125.00	179.51	223.00	360.00	360.00	200.00	61.93
	b) Rehabilitation & reclamation	11000 fam.	1206.95	50.00	50.00	100.00	430.00	430.00	146.95	-
C)	Project Fac.: Roads	60 Km.	120.00	100.00	20.00	-	-	-	-	-
	ii) Buildings	624 nos.	200.00	100.00	100.00	-	-	-	-	-
D)	Establishment	-	556.00	146.91	71.00	78.00	75.00	75.00	75.00	38.09
E)	Other items of works	-	564.21	582.72	-155.42	-198.61	-81.21	73.23	152.27	25.80
	Total	-	7500.00	1378.24	924.29	1175.00	1500.00	1400.00	900.00	222.47

Note: These estimates are compiled from the data collected from the office of the C.C.E., RMP Or

ANNEX VII
Table 2

THE FINANCIAL COSTS OF THE DAM & APPURTNENT WORKS OF RMP

(Figures in lakh Rs.)

Sl. No.	Particulars/	1973-74	74-75	75-76	76-77	77-78	78-79	79-80	80-81	81-82	82-83	Total
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)
1)	I-Civil works	9.22	53.8	59.6	140.9	568.3	492.6	583.8	491.8	354.8	96.65	3301.5
2)	Machinery & equipment (Special T&P)	36.51	6.21	18.8	32.6	16.9	30.0	-40.0	-30.0	-29.1	-	41.9
3)	B-Land:											
	a) Land acquisition.	1.85	14.3	35.9	18.7	233.7	223.0	360.0	360.0	200.0	61.9	1509.4
	b) Rehabilitation & Reclamation.	-	-	-	-	100.0	100.0	430.0	430.0	146.9	-	1206.9
4)	Project facilities:											
	a) Roads	38.19	22.7	13.1	29.5	16.5	-	-	-	-	-	120.0
	b) Buildings	12.86	56.2	31.0	44.5	55.5	-	-	-	-	-	200.0
5)	Management	13.33	27.9	47.2	58.5	71.0	78.0	75.0	75.0	75.0	38.1	556.0
6)	Other items of work	148.8	32.2	179.5	108.8	123.4	-198.6	-81.2	73.2	152.3	25.8	564.2
	Total	260.8	213.2	385.1	433.6	1185.3	1175.0	1324.6	1400.0	900.0	222.5	7500.0
	At base yr.prices.	260.8	197.4	330.1	344.2	940.9	932.7	1051.5	1111.4	714.5	176.6	6060.1

Note: The figures upto 1976-77 are the realised expenses compiled from the data collected from the FA & CAO, RMP, Orissa and from 1977 onwards the projected figures are compiled from the revised cost estimate of the project with suitable adjustments for the year 1977-78 to maintain the total figures in column (13) intact.

ANNEX VII
Table 3

FINANCIAL COSTS OF THE RENGALI POWER PROJECT

(Figures in lakh Rs.)

Sl. No.	Sub-head	Particulars/ year	1974-75	75-76	76-77	77-78	78-79	79-80	80-81	81-82	82-83	Total
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)
1)	B	Generating plant and machinery	90.43	6.21	18.78	29.63	56.00	734.33	387.34	217.16	23.22	1563.10 (65.13)
2.		Tools & Plants	1.78	2.13	28.25	26.50	15.00	5.00	3.00	2.34	-	84.00 (3.5)
3.	C	Buildings & roads	4.69	6.35	20.00	25.37	10.00	10.59	10.00	5.00	-	92.00 (3.83)
4.	A	Power House	-	-	5.02	70.00	75.00	300.00	149.98	-	-	600.00 (25.00)
5.	Management: Establishment & Audit		2.81	3.15	5.16	11.00	14.00	19.00	20.00	20.00	7.08	102.50 (4.27)
6.	Receipts & Recoveries		-	10.05	-7.39	7.50	5.00	1.08	-2.34	-10.36	-45.14	-41.60 -(1.73)
7.	Total		99.71	30.19	69.82	170.00	175.00	1070.00	567.98	234.14	-16.84	2400.00
8.	Total at base year prices		92.32	25.88	59.86	145.75	150.03	917.34	486.95	200.73	-14.14	2064.43

Note: i) Figures in column (4) have been collected from the Revised cost Estimate of Rengali Dam Project, collected from CCE, Rengali Project.

ii) All other figures have been compiled from the Bar Chart of Rengali Power Project.

iii) The figures in brackets of column (13) are the percentages of the total costs.

ANNEX VII
Table 4

THE COSTS OF THE RMP AFTER ITS COMPLETION (i.e. the costs of embankment as well as the O & M costs)

(Figures in lakh Rs. at base year prices)

Sl. No.	Major components of the project	Initial investment	Projection of costs for the life span of the project 1983-84	84-85	85-86	86-87	87-88	1988-98	98-2008	2008-18	2018 - onwards
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
1)	Dam & appurtnent works:	6060.1	-	-	-	-	-	-	-	-	-
i)	cost of B-Land	2160.9									
ii)	costs without land	3899.2									
iii)	O & M costs	-	38.99	38.99	38.99	38.99	38.99	42.89	48.74	58.49	58.49
2)	Embankments:										
i)	Initial costs	1500.0	300.00	300.00	300.00	300.00	300.00	-	-	-	-
	a) labour costs	900.0	180.00	180.00	180.00	180.00	180.00				
			(103.5)	(103.5)	(103.5)	(103.5)	(103.5)				
	b) Other costs	600.00	120.00	120.00	120.00	120.00	120.00	-	-	-	-
ii)	O & M costs	-	-	-	-	-	-	15.00	16.50	18.75	22.50
	a) Labor costs	-	-	-	-	-	-	7.50	8.25	9.37	11.25
								(4.31)	(4.74)	(5.39)	(6.47)
	b) Other costs	-	-	-	-	-	-	7.50	8.25	9.38	11.25
3)	Power Project	2064.43									
i)	O & M. costs	-	25.80	25.80	25.80	25.80	25.80	30.97	36.13	41.29	41.29
	Total costs	-	364.79	364.79	364.79	364.79	364.79	88.86	101.37	118.53	122.28
	Social costs, I	-	288.29	288.29	288.29	288.29	288.29	85.67	97.86	114.55	117.50
	Social costs, II	-	506.52	506.52	506.52	506.52	506.52	303.90	316.09	332.78	335.72

Note: i) The figures within brackets are values with adjustment to shadow prices of factors.

ii) While the social costs, I takes into account the shadow prices of factors only, the social costs, II has taken into consideration both the social costs of land and the shadow prices of factors.

ANNEX VII
Table 5

ECONOMIC COSTS OF THE DAM & APPURTNENT WORKS OF THE RMP, ORISSA

(Figures in lakh Rs.)

Sl. No.	Particulars	1973-74	74-75	75-76	76-77	77-78	78-79	79-80	80-81	81-82	82-83
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
1.	I-Civil Works:	9.22	53.80	59.58	140.94	568.30	942.61	583.79	491.77	354.81	96.65
	a) Labour costs(20%)										
	i)Skilled lab.	0.92	5.38	5.96	14.09	56.83	94.26	58.38	49.17	35.48	9.66
	ii)Unskilled lab.	0.92 (0.53)	5.38 (3.09)	5.96 (3.43)	14.09 (8.10)	56.83 (32.68)	94.26 (54.20)	58.38 (33.57)	49.17 (28.28)	35.48 (20.40)	9.66 (5.56)
	b) Cement(30%)	2.76 (1.83)	16.14 (10.69)	17.87 (11.84)	42.28 (28.08)	170.49 (112.9)	282.78 (187.4)	175.14 (116.1)	147.53 (97.77)	106.44 (70.54)	28.99 (19.22)
	c) Steel (25%)	2.30 (1.54)	13.45 (8.98)	14.89 (9.94)	35.24 (23.52)	142.07 (94.82)	235.65 (157.3)	145.95 (97.41)	122.94 (82.05)	88.70 (59.20)	24.16 (16.13)
	d) Fuel (2%)	0.18 (0.05)	1.08 (0.31)	1.19 (0.35)	2.82 (0.82)	11.36 (3.30)	18.85 (5.47)	11.68 (3.39)	9.84 (2.85)	7.09 (2.06)	1.93 (0.56)
	e) Others	2.12	12.37	13.70	32.42	130.71	216.80	134.27	113.11	81.61	22.23
2)	Machinery & Equp.	36.51	6.21	18.75	32.59	16.91	30.00	-40.00	-30.00	-29.04	-
3)	Land:	1.85 (0.62)	14.28 (4.78)	35.97 (12.05	18.73 (6.84)	333.69 (162.8)	323.00 (178.9)	790.00 (522.7)	790.00 (597.8)	346.95 (373.5)	61.93 (238.98)
	A) Land acquisition:										
	a)Land(66.5%)	1.23 (0)	9.49 (0)	23.92 (0)	12.45 (0.57)	155.40 (0.57)	148.29 (20.27)	239.40 (41.30)	239.40 (116.4)	133.00 (183.2)	41.18 (218.23)
	b)Properties(33.5%)	0.62	4.79	12.05	6.27	78.28	74.71	120.60	120.60	67.00	20.75

(contd....)

(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
B) Rehab.& Reclaim:		-	-	-	-	100.00	100.00	430.00	430.00	146.95	-
a)Labour costs(40%)											
i) Sk.Lab.(10%)		-	-	-	-	10.00	10.0	43.00	43.00	14.69	-
ii)Unsk.lab.(30%)		-	-	-	-	30.00	30.00	129.00	129.00	44.09	-
						(17.25)	(17.25)	(74.17)	(74.17)	(25.35)	
b)Cement (5%)		-	-	-	-	5.00	5.00	21.50	21.50	7.35	-
						(3.31)	(3.31)	(14.25)	(14.25)	(4.87)	
c)Steel (5%)		-	-	-	-	5.00	5.00	21.50	21.50	7.35	-
						(3.38)	(3.38)	(14.35)	(14.35)	(4.91)	
d) Others (50%)		-	-	-	-	50.00	50.00	215.00	215.00	73.47	-
4)Project Facilities: Roads & Bldg.		51.05	78.87	44.12	73.96	72.00	-	-	-	-	-
		(44.60)	(68.91)	(38.55)	(64.63)	(62.91)					
a)Lab. costs(20%):											
i)Sk.lab.(10%)		5.10	7.89	4.41	7.39	7.20	-	-	-	-	-
ii)Unsk.lab(10%)		5.10	7.89	4.41	7.39	7.20	-	-	-	-	-
		(2.94)	(4.53)	(2.54)	(4.25)	(4.14)					
b)Cement(12.5%)		6.38	9.86	5.52	9.24	9.00	-	-	-	-	-
		(4.23)	(6.53)	(3.65)	(6.13)	(5.96)					
c)Steel (12.5%)		6.38	9.86	5.52	9.24	9.00	-	-	-	-	-
		(4.26)	(6.58)	(3.68)	(6.17)	(6.01)					
5) Management		13.32	27.86	47.17	58.55	71.00	78.00	75.00	75.00	75.00	38.09
6)Other work items		148.84	32.18	179.47	108.82	123.41	-198.61	-81.21	73.23	152.27	25.80
Total(base Yr.level)		260.78	197.40	330.13	344.20	940.93	932.75	1051.49	1111.36	714.45	176.60
Social costs		250.89	167.37	292.54	300.39	689.28	637.97	729.96	864.70	667.59	289.65

Note: i) The figures within brackets are the values after adjustment to shadow prices and taxes etc.
ii) The % within bracket in column (2) are our own assumptions. Of course these are based on our discussions with the project authorities and the water resource experts.

ANNEX VII
Table 6

ECONOMIC COSTS OF THE RENGALI POWER PROJECT

(Figures in lakh Rs.)

Sl. No.	Particulars	1974-75	75-76	76-77	77-78	78-79	79-80	80-81	81-82	82-83
1)	Generating Plant & Machi: i) Market prices	90.43	6.21	18.78	29.63	56.00	734.33	387.34	217.16	23.22
	ii) Social prices	81.21	5.58	16.86	26.61	50.29	659.43	347.83	195.01	20.85
	a) Costs of machinery	76.86	5.28	15.96	25.18	47.60	624.18	329.24	184.58	19.74
	" excluding taxes*	67.64	4.65	14.04	22.16	41.89	549.28	289.73	162.43	17.37
	b) Other expenses	13.57	0.93	2.82	4.45	8.40	110.15	58.10	32.58	3.48
2)	Tools & Plants	1.78	2.13	28.25	26.50	15.00	5.00	3.00	2.34	-
	Social prices	1.57	1.87	24.86	23.32	13.20	4.40	2.64	2.06	-
3)	Bldgs.& Power house	4.69	6.35	25.02	95.37	85.00	310.59	159.98	5.00	-
	Social prices	3.56	4.80	18.98	72.37	64.51	273.68	121.39	3.79	-
	a) Labour costs: i) Sk.(10%)	0.47	0.64	2.50	9.54	8.50	36.06	15.99	0.50	-
	ii) Unsk.lab.(10%)	0.47	0.64	2.50	9.54	8.50	36.06	15.99	0.50	-
	Social costs	0.27	0.37	1.44	5.48	4.89	20.73	9.19	0.29	-
	b) Cement (30%)	1.41	1.90	7.51	28.61	25.50	108.18	47.99	1.50	-
	Social prices	0.93	1.26	4.97	18.96	16.90	71.69	31.80	0.99	-
	c) Steel (25%)	1.17	1.59	6.25	23.84	21.25	90.15	39.99	1.25	-
	Social prices	0.78	1.06	4.17	15.91	14.18	60.17	26.69	0.83	-
	d) Fuel (2%)	0.09	0.13	0.50	1.99	1.70	7.21	3.20	0.10	-
	Social prices	0.03	0.04	0.15	0.55	0.49	2.09	0.93	0.03	-
4)	Management	2.81	3.15	5.16	11.00	14.00	19.00	20.00	20.00	7.08
5)	Receipts & recoveries	-	10.05	-7.39	7.50	5.00	1.08	-2.34	-10.36	-45.14
	Total at Mkt.prices	99.71	30.19	69.82	170.00	175.00	1070.0	567.98	234.14	-16.84
	" at shadow prices	89.15	25.45	58.47	140.80	147.00	957.59	489.52	210.50	-17.21
	" with shadow prices at base year level	82.55	21.82	50.13	120.71	126.03	820.97	419.68	180.47	-14.75

Note: In calculating the social prices of (1) and (2), the central sales tax and duties are deducted (which is 12% at present).

ANNEX VII
Table 7

THE SOCIAL COSTS OF LAND ACQUISITION FOR THE RIP, ORISSA

Sl. No.	Items	Area required for the project (in acres): Original estimate	Area required for the project (in acres): Revised estimate	Net productivity per acre at base year prices (in Rs.)	Total productivity foregone at base year prices (in lakh Rs)
(1)	(2)	(3)	(4)	(5)	(6)
A - Land acquisition for the reservoir:					
i)	Village sites	602	407	250	0.50
ii)	Low land	3613	8216	350	28.76
iii)	Medium land	19569	10473	300	31.42
iv)	High land	4114	4008	135	5.41
v)	Orchards	1081	121	200	0.24
vi)	Waste land private (patita)	2709	973	Nil	Nil
vii)	Reserve forest	2208	2208	250	5.52
viii)	Village "	53151	58326	250	145.81
ix)	other lands (like river-nalas, hillocks and anabadi lands)	13203	17586	Nil	Nil
	Total-A	100250	102318	-	217.66
B-Land acquisition for works:					
i)	Private land (medium land)	190	190	300	0.57
ii)	Govt. land (useful but Anabadi)	1360	1360	Negl.	-
	Total A & B	101800	103868	-	218.23

Note: i) The net productivity figures for (i) to (v) have been collected from the "Bench Mark Survey of SFDA, Dhenkanal district, Orissa". But the figures used by us have been adjusted to 1973-74 level of prices. The productivity forest have been taken from the project reports.

ii) We have assumed that, at least, 50% of the village sites were being used for growing vegetables or pulses.

ANNEX VII
Table 8

SOCIAL COSTS OF LAND FOR DIFFERENT YEARS, RMP, ORISSA

Sl. No.	Year	Land acquired for works or submerged by the reservoir (in acr.)	Cumulative area (in Acrs.)	Social costs of the land acquired (in lakh Rs)	Cumulative social costs of land in terms of productivity foregone (in lakh Rs.)
(1)	(2)	(3)	(4)	(5)	(6)
1.	1973-74	100	100	Nil	Nil
2.	74-75	500	600	Nil	Nil
3.	75-76	700	1300	Nil	Nil
4.	76-77	250	1550	0.57	0.57
5.	77-78	-	1550	-	0.57
6.	78-79	9263	10813	19.70	20.27
7.	79-80	9880	20693	21.03	41.30
8.	80-81	35321	56014	75.14	116.44
9.	81-82	31369	87383	66.73	183.17
10.	82-83	16485	103868	35.06	218.23
11.	1983-84 onwards	-	103868	-	218.23

Note: i) For the first three years the costs of land are assumed to be nil because the land acquired were unproductive lands.

ii) The submergence of the reservoir is assumed to start from 1978-79.

iii) The social costs of lands for the reservoir area have been calculated on the basis of percentage of submergence in each year.

ANNEX VII
APPENDIX 1

TAXES & DUTIES OF THE BASIC INPUTS

The following are the duties and taxes of the basic inputs, which are required for the construction of the RMP.

(1) Cement:
(a) Market price Rs.450 per MT.
(b) Basic duty Rs.100 per MT.
(c) Central excise rate 5 percent
(d) State sales tax 7 percent, and
(e) Octroi rate 1 percent

On the basis of these figures the social price of cement has been estimated at Rs.298 per MT, which is 66.27% of the market price. Thus, the rest 33.73% constitute the taxes and duties of cement.

(2) Steel:
(a) Market price Rs.3000 per MT.
(b) Basic duty, on an average Rs.750 per MT.
(c) Central excise rate 5 percent,
(d) State sales tax 3 percent, and
(e) Octroi duty 1 percent.

With the help of this information the social price of steel has been calculated to be Rs.2002 per Mt, which is 66.74% of the market price. Thus, the taxes and duties constitute 33.26% of the market price.

(3) Fuel: The fuel required for the project has been broadly divided into two categories, viz., petrol, and diesel and other lubricants. We have estimated below the duties and taxes on each of the items:

(i) Petrol:
(a) Market price Rs.4,500 per Kilo litre
(b) Basic duty Rs.2,750 per Kilo litre
(c) Central excise rate, 5% and
(d) State sales tax and octroi 5%.

With the help of these data, when we calculated the social price of petrol, it worked out to Rs.1,341 per Killo litre, which is 29.8% of the market price of petrol. Hence, the taxes and duties constitute 70.2% of the market price of this input.

(ii) Diesel: (a) Market price Rs.1590 per kilo litre
(b) Basic duty, Rs.1000 per kilo litre
(c) Central excise rate 5% , and
(d) Sales tax and octroi 5%.

With this data, the social price of diesel has been estimated at Rs.445 per kilo litre, which is 28.02% of the market price, of the same. Thus, taxes and duties constitute 71.98% of the market price of this input.

Thus as a method of simplification we have approximated that the taxes and duties constitute 71% of the market prices of fuel products.

(4) Machinery for the Power Project:

On the basis of the information obtained from the Marketing Division of BHEL, the central excise duty levied on the generating equipments and machinery is 8% of the value of these commodities. In addition to the excise duty there is 4% central sales tax on all these products. However, there would be no State sales tax and octroi on these equipments and machinery because they will be directly supplied by BHEL to the RMP.

Sources: (i) The figures on basic duty and central excise rates chargeable on cement, steel and fuel are collected from the central Excise Tariff, Working Table, Ministry of Finance, GOI (of course collected from the Planning Commission sources).

(ii) The State excise octroi and the market price figures of these items are collected from the Rengali Project Authorities.

(iii) The duty and tax figures of the power project equipments are collected from the Joint Secretary (Power), Ministry of Energy, Government of India.

ANNEX VIII
APPENDIX I

THE COMPUTER PROGRAMME USED IN UNDERTAKING THE SBCA OF THE RMP

(i) NAME OF THE PROGRAMME: "ASIT"
(ii) USER   BINAYAK RATH
(iii) MONITOR   I.I.T. KANPUR
(iv) THE PROGRAMME DECK:

```
      DIMENSION BT(70),CT(70)
      N=60
      OPEN (UNIT=21,FILE='D.DAT')
      READ (21,*)(BT(I),CT(I),I=1,N)
      CLOSE (UNIT=21)
      PRINT 105
      PRINT 106
      PRINT 103
      AI=.02
      STEP=.01
    5 CONTINUE
      AI=AI+STEP
      IF(AI.GE.1.)GO TO 107
      B=0.
      C=0.
      DO 20 I=1,N
      B=B+BT(I)/(1.+AI)**(I-1)
      C=C+CT(I)/(1.+AI)**(I-1)
   20 CONTINUE
      ANPV=B-C
      BCR=B/C
      PRINT 25,AI,B,C,ANPV,BCR
      IF((B-C).GT.0.)GO TO 5
      AI=AI-STEP
      STEP=STEP/10
      IF(ABS(B-C).LT.0.00075)STOP
      GO TO 5
  103 FORMAT(5X,'  DISC%',12X,'BENEFITS',9X,'COSTS',8X,'NET BR V
      18X,'B-C RATIO'/)
  105 FORMAT(5X,'**********************************************')
  106 FORMAT(10X,'SBCA OF RENGALI MULTIPURPOSE PROJECT,ORISSA')
      PRINT105
   25 FORMAT(5X,F14.10,2X,4F14.4)
  107 STOP
      END
```

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